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THE AMERICAN PACIFIC CABLE.

Closely following the British Pacific cable, the American Pacific cable has been completed, and thanks to the courage and enterprise of the Mackays and the Commercial Cable Company, this country is now in direct communication with all its dependencies and possessions in the Far East. As soon as the next link is carried to the shore of China, we shall have an American cable route of our own all the way to that part of the world with which the destinies of this country are being so closely interwoven, and shall command direct communication with it as freely and instantaneously as now with Europe. The benefits to the United States from this work will be immediate, and in the long run incalculable; and the memory of the late John Mackay will be forever associated with this great and honorable achievement, on which all would have been glad to see him alive to enjoy the congratulations extended to his son by President Roosevelt. Not only can our government at once administer in the Philippines with greater efficiency, but our merchants can save enormously in the time and cost of their cable messages and push their Oriental trade with greater success than ever before. We trust the cable will be profitable, and beg to offer our hearty felicitations to the managers and leaders in this great undertaking, which, in its way, means just as much as the battle of Manila, and is a bloodless, peaceful conquest over the obstacles of Nature for the lasting good of mankind. An interesting reflection is whether this great work would be now completed and so satisfactorily, if those had prevailed who fought so strenuously for government ownership of a Pacific cable. None, we believe, will deny the advantage of private ownership in the case of such a great auxiliary to commerce, and the government should be thankful that it was not burdened with a charge that held possibilities of a kind now being revealed in the investigation of the Postmaster General's department. Indeed, it may be said that Mr. Mackay in taking up the project as a commercial venture, incidentally performed a considerable public service.

THE GROUNDED WIRE AS A PROTECTION AGAINST LIGHTNING.

One of the papers presented at the recent Niagara Falls convention of the American Institute of Electrical Engineers was read by Mr. Ralph D. Mershon on the important question of the protective influence of grounded aerial wires over transmission wires. Lightning is one of the outstanding hazards of electrical transmission which cannot be reduced to simple arithmetic, and for which no reliable estimates can be prepared in advance. Some plants suffer heavily by lightning every year. Others never spend a dollar on the score of injuries due to lightning. Much depends upon the locality of the plant and the topographical conditions.

Mr. Mershon makes a definite attempt to compute the shielding influence which a grounded wire exercises over a working wire in its neighborhood. The computation indicates that a marked degree of shielding may be expected. In a question of this sort, however, theory can only be taken as a rough guide. There is nothing more wonderful than the freaks of lightning. Sometimes lightning seems to delight in bidding defiance to every known law of electromagnetism. The forces invoked are so sudden and so powerful that the phenomena are much more complex than any we deal with experimentally. It is only by accumulating experience and practical observation on the protective value of safeguards against lightning

that we can form a reliable estimate of their value. There have been many instances of the use of grounded guard wires over transmission circuits, and the data have been collected to a certain extent. These data seem to indicate a distinct protective influence afforded by the aerial grounded wire. In telegraphy it has long been known that the topmost wires of a number of wires on a pole line were more likely to suffer by lightning than a lower wire, or a single wire. We know that to bury a wire underground is to insure it against lightning disturbance, except for connections with overhead wires. In other words, a subterranean or subaqueous cable conductor, whose terminals were not allowed to reach above ground, would be perfectly safe from lightning. The use of grounded aerial wires over a working wire on a pole line is a rough attempt to bring the ground above the level of the working wire, and ought to have some advantage.

As for the barbed wire, we quite agree with Mr. Mershon that the barbed wire presents no advantage over plain wire. Barbed wire fences may keep out cattle, but they cannot keep out lightning. Even if there were an advantage in barbed guard wires over plain wires, it would have to be a marked advantage to compensate for the great disadvantage of handling and suspending barbed wire. It is awkward to transport, handle and suspend. It is also much more apt to cross mechanically with other wires than a smooth wire. It is difficult to see on what theory the use of barbed lighting guard wire could be supported. It is probably a relic of the belief in pointed lightning rods, and while there has been some argument advanced for sharp points on a lightning rod, this question is a moot point. At all events, we do not find people taking pains to sharpen the tips of their lightning rods every summer, and it is certain that a great many lightning rods act effectively in which the tip has been very blunt.

RAILWAY MOTORS IN SERVICE.

The Niagara paper of Mr. Renshaw, an abstract of which appeared in our issue of last week, is a clearly wrought piece of investigation that ought to set engineers to thinking. The modern railway motor is really a very wonderful machine. Those of us who can run back in memory to the early days of the art realize fully how great has been the improvement, and what important feats of engineering are embodied in the standard railway equipments in use to-day. A railway motor works under manifold disadvantages. It has to stand many and severe overloads and the roughest sort of usage; it is so boxed in to protect it from dirt and moisture that it radiates heat slowly, and it is run so continually that it never gets a chance to really cool off properly. Mr. Renshaw's curves show plainly how severe are the temperature conditions even under average service. The coils may have to work for hours at a temperature of from 80° to nearly 100° Centigrade, and during the rest in the car barn may not get down to within 20° C. of the atmospheric temperature. Mr. Renshaw's method of getting the temperature was certainly effective, and while at times the armature may have risen a trifle higher than the figures recorded, the point investigated in the inside of the field coils probably fairly represents the average conditions. That insulation stands up for a long life under the trying ordeal speaks volumes for its quality.

By an ingenious application of wattmeters, Mr. Renshaw succeeded in getting the mean current corresponding to the service conditions of heating, so that an equivalent load can be fairly determined. But it seems to us that the thing even more necessary than the reduction of the service load to an equivalent uniform load is a supplementary investigation by the same method of heating conditions near the limit of load. Danger to the insulation comes from extreme conditions and the thing of most importance practically is the behavior of the motor when severe overloads are thrust upon it after it has already become severely heated. In one of Mr. Renshaw's curves the effect of this sort of thing is excellently well shown. In this instance a couple of trips were made with a trailer attached, and while the average current for all day was changed by less than 2.5 per cent., the immediate effect was to drive the maximum temperature, which is the real danger factor, up from 75° C. to 98.5° C. It is evident that these overload conditions are specially worth investigating and we hope that Mr. Renshaw will take up the work of doing it.

That standard railway motors are often seriously overloaded in service is tolerably clear, and while the increment of current may not seem especially severe, as shown on the ammeter, the increased heating may be all out of proportion to it. It is by no means impossible that enclosure of the motors has been slightly overdone in some cases, and that a lower maximum value of the temperature could be attained by some special precautions for ventilation. In spite of all the current work of improvement, the service requirements of railway operation more than keep pace, and motors are continually called upon for severer efforts. A more frequent study of the actual conditions in service would give a great deal of valuable information, and the results would, we fancy, often be rather startling. It is not always safe to judge one route by another in selecting motors for the equipment of the line, and according to our experience people seldom err on the side of safety.

STORAGE BATTERY LOCOMOTIVES.

Mr. Sessions' Institute paper is interesting evidence of the change in opinion regarding storage batteries in the last few years. After twenty years or so of struggle the storage battery is now gradually coming into its own. In its earlier days it suffered greatly from the unwise enthusiasm of its friends, from too vigorous exploitation and from inherent defects that could be worked out only by long experience. More than from anything else it suffered by reason of general ignorance of its real properties. Through patient experimentiug and at the cost of much time and money, it has come to be understood and each year gains importance as a most convenient and useful auxiliary in many branches of applied electricity. Mr. Sessions has done a useful service to the profession in gathering in convenient and systematic form a large amount of valuable data regarding the storage battery locomotive. That it has manifest advantages in case of industrial railways is beyond dispute. The mere fact that it can run on any track that will support it, permanent or temporary, is a very material advantage, while its freedom from fire dangers allows it to be used in places where an ordinary locomotive could not safely be employed. Data on that exact performance of such machines are presented in a cautious and conservative spirit. Mr. Sessions, indeed, was charged in the discussion with being over-conservative in his claims as to the performance of the batteries, but in the light of past experience over-conservatism on this particular subject should be easily forgiven.

Indeed in one particular we should be inclined to go even further than Mr. Sessions in caution. A one-hour discharge rate is a pretty stiff proposition for any battery to face, and with batteries as they are found in commerce, it is likely to produce more rapid depreciation than economy would dictate. Particularly in the case of

locomotives for haulage, where considerable weight is needed for securing the requisite adhesion, we are inclined to think that the discharge rate should be kept low both in starting and running. A battery does so much better work on a 6 or 8-hour discharge rate, to say nothing of lessened depreciation, that it should be kept at about that pace as far as is feasible. Of course, grades and curves have to be taken under unfavorable conditions, but much of the advantage of a storage system is lost if it has to be helped out by a trolley or third-rail system, even in the way of charging while in action. For convenience, a locomotive should have battery capacity enough for its day's work with perhaps a little charging during enforced idleness, and then it can be regularly charged at night. It is hard to reduce this condition to a definite equivalent discharge rate, since locomotive haulage is the most irregular sort of task that could well be imagined, but it corresponds in general to a rather conservative condition. It is interesting to learn that regular charging en route has proved successful, but it strikes us as an inadvisable complication in the ordinary case. As to methods of control, Mr. Sessions is inclined to favor the very simple one of motors in parallel and batteries in four groups, with intermediate resistance steps to soften the shock in passing from one grouping to another. Rheostatic control is rather undesirable in battery working, as was remarked in the discussion, but it seems the lesser evil as compared with the strains put upon the battery by demanding sudden acceleration. Storage batteries have been much improved in life during recent years, but it is still desirable to order their existence after strict hygienic rules.

THE FACTORS WHICH AFFECT THE ENERGY LOSSES IN ARMATURE CORES.

A paper embodying a mass of experimental data, including, it would seem, twelve thousand observations, was communicated by Messrs. Esterline and Reid to the recent Niagara convention of the American Institute of Electrical Engineers, a brief abstract of which appears elsewhere in this issue. The object of the investigation was to study iron losses in a small experimental dynamo, under conditions as nearly practical as the small scale of construction would permit. The field ring and the bearings were almost the sole constant portions of the experimental dynamo, the field cores and the armature cores being varied in the different experiments. The number of pairs of poles was varied between one and four, and the pole cores tried were both laminated and unlaminated. The armature was tried both smooth-cored and tooth-cored, and also in several core depths of each type. The miniature dynamo was driven by a little motor through a spiral spring dynamometer, and the increase of torque with dynamo field excitation measured the iron losses under the conditions of each experiment.

The iron losses per unit mass involve both hysteresis and eddy currents. The former increases directly with the frequency, the latter as the square of the frequency. The former also varies as the 1.6th power of the density or gaussage, the latter as the square, approximately. The iron loss thus depends in theory upon two variables in any given structure—frequency and gaussage. But owing to the fact that the gaussage is never uniform throughout the entire cross-section of the armature, the loss depends in practice upon four variables, namely, frequency, average gaussage, depth of armature core and number of poles. Looking at the same facts in another way, the iron losses per unit mass ought to be the same in a shallow smooth-cored armature as in a deep smooth-cored armature, provided that the frequency and average armature gaussage is maintained constant. But in a deep armature the gaussage varies considerably between the superficial layer and the deepest layer; so that the integrated core loss per pound for a given gaussage and frequency will be appreciably greater than in a shallow core in which the gaussage is more nearly uniform, or varies less from the average.

The results of the investigation are expressed graphically in eleven curve sheets accompanying the work. There is not an equation in the entire paper. This analysis and presentation has certain advantages and certain disadvantages. The principal advantages are that the results are readily open to inspection, and are not likely to be influenced by preconceived opinions on the part of the observers. The principal disadvantage is that the results are incapable of being summed up and reduced to explicit statement, without a considerable expenditure of effort on assimilation and digestion. Most of the curves, moreover, are drawn with the independent variable on the line of ordinates and the dependent variable on the line of abscissæ, so that to bring the curves and diagrams to the customary opposite condition, the reader must first hold the page sideways and then inspect it in a mirror, or perform the equivalent operations mentally. It would seem that the curves are susceptible of yielding much information under analytical treatment. Certain inferences are immediately deducible from an inspection of them. Taking the diagram connecting watts per pound as dependent upon frequency, it is evident that the core loss per pound of tooth-cored armatures is 38 per cent. greater than that of smooth-cored armatures for nearly all frequencies up to 120 cycles per second. The range of variation is surprisingly small, being between 35 per cent. at lowest frequencies, up to 41 per cent. at the highest. Each of the two curves may be fairly represented by a linear equation containing only the first and second powers of the frequency, according to theory, and it seems to be a mere chance, depending upon the structural dimensions selected, that this ratio should remain nearly constant.

In the succeeding diagram, connecting core loss per pound with gaussage, the results with the tooth-cored armatures were always about 37 per cent. greater than with smooth-cored armatures at all gaussages above 9 kilogausses. Below 9 kilogausses—that is, for low average densities—the ratio does not remain uniform. The physical interpretation of the result appears to be that the tooth-cored armatures introduce losses in the field poles due both to eddies and hysteresis, following the same generic law as that controlling the losses in the armature core. In the diagram showing the effect of laminating the field poles referred to kilogauss-cycles per second, the loss with unlaminated poles is evidently almost exactly 20 per cent. greater than the loss with laminated poles throughout the entire range of the independent variable. It would be interesting to know how far this ratio of 1.2 would be likely to hold in larger structures in practice. It must be expected to vary with the air-gap and with the armature reaction, as well as with the thickness of the field laminæ; but it is possible that the ratio might not vary widely.

Like all papers that embody a large amount of experimental observation, this paper grows in interest with study; but there seems to be room for another paper on the mathematical analysis of this. The broad generalization to which the paper leads is that in order to secure the great mechanical advantages offered by toothed-core armature construction we not only increase the armature iron losses by about one-third, but we also have to laminate the poles, or else increase the loss again one-fifth. On the other hand, however, tooth-cored construction somewhat tends to reduce air-gap reluctance, and thus enables a slight reduction to be made in field copper loss.

Details of American Street Railway Operation.

In connection with the figures quoted in these pages last week from the United States Census report on American street railways, based on the inquiry conducted last year, a variety of other data of interest may be noted. In fact, while the final report will not make its appearance for some time, there is in the preliminary bulletin such a wealth of material it is particularly difficult to make a selection.

It was already known that electric railways were doing considerable lighting and power business, owing to the operation of incidental apparatus or the ownership of lighting companies that had been thoroughly absorbed. From the Census Bulletin it now appears that the railway companies received no less than $7,703,574 in the year 1901-2 from the sale of current for light and power; while probably a little work of a kindred character is concealed in the miscellaneous receipts of $3,853,420. As to the electric lighting of the cars, it is noted elsewhere in the bulletin that there were 66,784 cars of all classes, of which 62,339 were lighted, and of these 55,673 had electric lights. If the lights were averaged at 10 to the car, it would represent nearly 600,000 lamps in daily service of that nature. More than half the cars are reported as being heated, and of these 19,021 or 63.07 per cent. were warmed by electrical apparatus, and 11,138 or 36.93 per cent. by stoves, hot water, etc. It may be repeated here that of the number of cars, 50,699 had electric equipment, so that many cars, such as trailers, had the benefit of electric lighting. Nor is this all, for the Census Office was careful to inquire as to the extent of electric lighting in the shops, car barns, etc., of the street railway companies, and it appears that no fewer than 5,282 arc lamps and 235,955 incandescent lamps were thus employed.

Returning to the subject of electric lighting, we note that in Table 17 the figures of 118 companies operating light and power plants are brought to account, while Table 18 gives details as to the apparatus. These companies show an aggregate of $6,469,726 from such service, of which $4,074,684 was from commercial lighting and $1,417,985 from public lighting, while no less a sum than $768,040 was earned from motor service. This income was derived from the operation of 33,863 arc lamps, of which 2,582 were open and 13,603 enclosed, in commercial use; and 10,868 open and 6,860 enclosed, in public use. In the way of incandescent lighting there were 1,442,685 lamps in service, of which the vast majority, or 1,313,303 were of 16 c.p.; while all but 19,026 of the larger number were in commerciai as distinguished from public, use. As to motor service, the street railway companies report supplying current to 10,049 stationary motors of 35,688-h.p. capacity. There were also 56,601 meters on the circuits. As has been noted, these are the figures given by 118 companies keeping separate accounts that enabled the compilation of these detailed statistics. There were, however, 252 companies which generated current for sale for light and power purposes.

We come now to the power plant figures of the street railway industry. There were 766 companies reporting the use of electricity or other mechanical motive power. The motive power, however, was not all generated in the 805 power-houses shown, as some companies rent motive power from light and power companies.

Steam was used by 540 companies as the primary motive power to generate electric current. The statistics concerning steam power classify the engines according to horse-power. There were, in all, 2,336 engines, with a total horse-power of 1,298,133, or 556 horse-power per engine. Of this number 1,588 engines were reported as having 500 horse-power or under each, and a total horse-power of 420,551, or an average of 265 for each engine. There were 431 engines having a horse-power of over 500 but under 1,000 each, the total horse-power being 297,757, of 691 per engine, and 317 engines having a total horse-power of more than 1,000 each, the total being 579,825 horse-power, or 1,829 per engine. The Pittsburg Railways Company, of Pittsburg, Pa., reports 47 engines, which is the largest number returned by a single company. The greatest amount of steam horse-power, 79,075, was reported by the Interurban Street Railway Company, of New York. The greatest number of large engines, *i. e.*, engines having more than 1,000 horse-power each, is reported by the Union Traction Company, of Philadelphia, which had 21 engines with a total of 37,800 horse-power, but the Interurban Street Railway Company, of New York, with only 15 engines, reported a horse-power capacity of 78,600; the Boston Elevated Railway Company, with 20 engines, reported a total of 48,200 horse-power.

As shown in a supplementary table there were 159 water wheels, with horse-power of 49,153, used as the primary power in the generation of electric current. The average horse-power per water wheel was 329. There were 129 wheels of 500 horse-power or less, 12 of over 500 and under 1,000, and 18 of 1,000 and under 2,000. Of the total horse-power 34,215, or 69.61 per cent., was reported by 16 companies in the States of California, Georgia, Maine, Minnesota and New York. The largest plant of this character was shown for the Twin City Rapid Transit Company, of Minneapolis, Minn. This company reported the use of 12 water wheels, 10 of which had 1,000 horse-power each. The report also shows 15 gas engines of 1,925 horse-power used for miscellaneous purposes; 301 auxiliary steam engines were reported, with horse-power of 10,074, used by 84 companies for miscellaneous purposes, driving pumps, etc.

There were 3,853 steam boilers reported, with an indicated horse-power of 903,205. The number of steam boilers exceeds the number of main and auxiliary steam engines by 1,216, while the horse-power of the engines exceeds that of the boilers by 405,002. The average capacity of the boilers is 234 horse-power. In general such steam plants should have an engine capacity larger than the generator capacity and a boiler capacity larger than the engine capacity; otherwise they would be wanting in a factor or margin of safety. An examination of the returns would indicate, however, that the apparent departure from this criterion is caused by different methods of providing reserve power, and that a great many power-houses have dynamo and engine capacity in duplicate or reserve against a possible breakdown of any unit or for changing the "load" over from one set of apparatus to another. The inference is, nevertheless, that the boiler capacity reported is being worked to its full possibilities. Direct-current and alternating-current dynamos are segregated according to the horse-power, and below are given the totals for the United States:

Generators.	Direct Current. Number.	Direct Current. H.P.	Alternating Current. Number.	Alternating Current. H.P.
Total	2,861	972,314	441	231,924
500 H.P. or under	2,324	422,924	329	61,935
Over 500 H.P., but under 1,000	328	218,934	54	36,418
1,000 H.P. and over	209	330,456	58	133,571

The use of direct-current machines, each having 1,000 horse-power or over, was reported by 59 companies. The use of small machines still predominated, more than three-fourths of all the machines being rated at 500 horse-power or less, their combined horse-power being 422,924, or 43.5 per cent. of the total for all classes. The detailed statistics of alternating current are presented in a supplementary table. There were 441 alternating-current generators reported, with a total of 231,924 horse-power. These machines were used by 163 companies, and of this number 128 reported that current was generated for sale for light or power. Considering all machines of this style, the average horse-power per machine was 526. There were 22 machines for each of which the indicated power was more than 2,000 horse-power. The Interurban Street Railway Company, of New York, reported 11 machines having over 2,000 horse-power each, the combined horse-power being 53,075, or an average of 4,825 for each machine. The Manhattan Railway Company (elevated), of New York, reported 4 machines with a total horse-power of 26,800, or an average of 6,700 for each machine.

In all cases where companies reported equipment of this character it is noted. There were 219 companies using auxiliary electrical equipment of some character and 105 which operated substations. The auxiliary equipment consisted of transformers, storage batteries, boosters, auxiliary generators, rotaries, and electric motors used in plant or substations for miscellaneous work. The total kilowatt hours and horse-power of current for the year and the average per day are shown for each company, with totals for each State and the United States. In a few cases this information was not available, and in others the companies were not in operation during the entire year, so the totals should not be accepted as exact. Attention is again called to the fact that in many cases the electric current is used for other purposes than the operation of the street railway, and therefore no comparison should be made between the car mileage and the quantity of current. It appears that the power plants noted, doing an electrical service, reported an output for the year of 2,261,484,397 kilowatt hours, or 6,249,910 kilowatt hours daily, this being roughly but not exactly equivalent to 3,018,320,717 h.p. hours for the year, or 8,338,190 h.p. hours daily. Hence the 1,204,238 horse-power of dynamo capacity would appear to be employed on the average as nearly as possible seven hours daily, which, all things considered, is probably very close to the mark.

Utica Home Telephone Company's Exchange.

BY F. L. MARTIN.

THE most recent advance of independent telephony in the east is marked by the opening of the exchange system at Utica, N. Y. The Utica Home Telephone Company was incorporated December 13, 1901, with an authorized capital stock of $500,000, and with an authorized bond issue of $1,000,000. The franchise was granted January 7, 1902, the construction work was started May 12, 1902, the system was put in operation April 1, 1903, and was complete in all respects May 1, 1903. In this period a complete telephone system was constructed, including the erection of an office building, a complete underground system, cable and aerial system, and including the installation of the central office and subscriber's sub-station equipment.

The system was formally put into operation April 1, 1903, with 1,300 subscribers connected. This number has been increased to over 1,800 in approximately 2 months' time, and the number of new lines being connected is being increased daily. The effect on the number of subscribers connected by the Bell Company is interesting, in that while on April 1, 1903, there were 1,600 Bell telephones connected, this number has already been decreased to about 1,200.

The rates of the Utica Home Telephone Company are: For business connections, metallic circuit, unlimited service, $36, and for residence connections, metallic circuit and unlimited service, $22.

The central office building consists of a handsome two-story structure of fire-proof construction. The front of the building presents a very fine appearance with an ornamental entrance of Gothic design. The first story front is finished in stone and the second in press brick with stone trimmings. The front of the first floor is devoted to well-appointed business offices and the remaining portion of the building for central office equipment, operator's quarters and stock rooms. Good sanitary conditions and ventilation provisions are made so as to make this building especially adapted for the purpose for which it was erected.

The outside construction work consists of a complete underground system in the business portion of the city, and a pole line system for distribution purposes and for leads into the residence districts and suburbs. A complete cable system was likewise erected and so distributed as to require the minimum amount of exposed line work. All telephone circuits are metallic. The underground system consists of 247,500 ft. of conduit, with 96 manholes. The cable system consists of 73,958 ft. of underground cable, 58,485 ft. of aerial cable. The underground cable is of Nos. 19 and 20 gauge, and the aerial cable No. 22 copper wire. Twenty-three 150-pair cables are terminated in the central office on the main distributing frame, thus making a total of 3,450 metallic circuits. There are provided 174 cable distributing points for connecting the cable system with the aerial distributing system. The aerial distributing system consists of 3,250 poles having carried thereon 593 miles of copper wire.

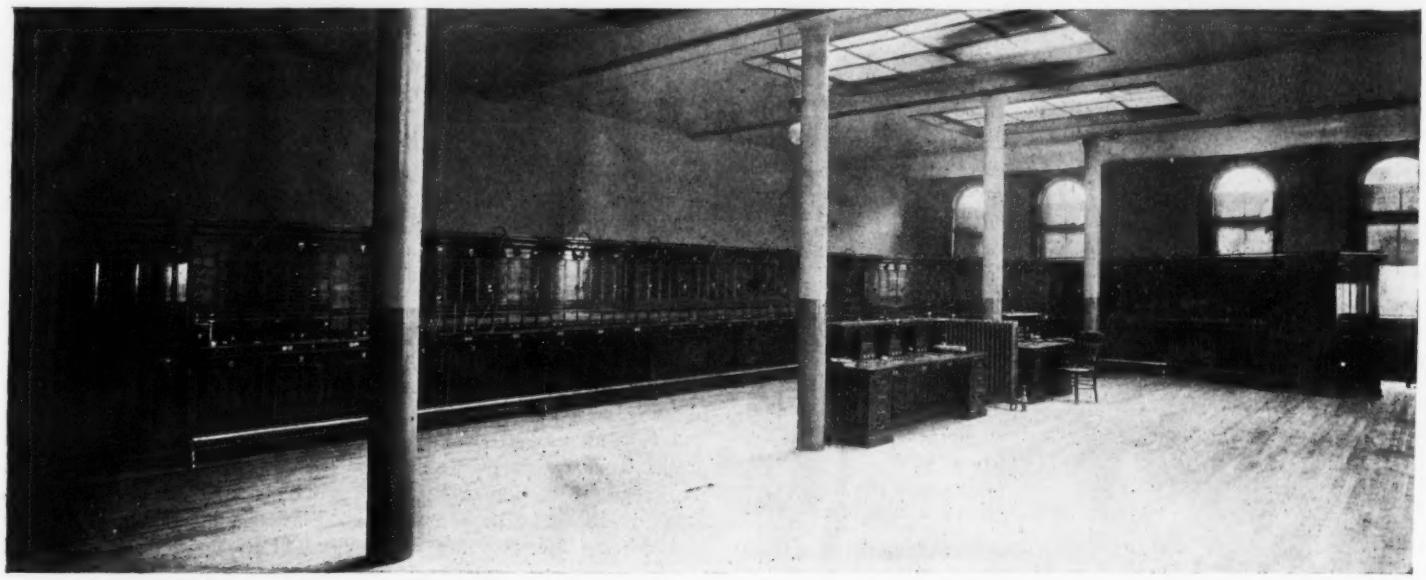


FIG. 1.—GENERAL VIEW OF UTICA HOME TELEPHONE COMPANY'S SWITCHBOARD.

It may be remarked that the rates of the Bell Company previous to April 1 were respectively $80 and $45. The local Bell Company, in order to compete with the rates of the Independent Company, made no changes in the above rates, but put into operation a system of party lines and limited service as follows:

Unlimited service, 2 party line, business, $63; unlimited service, 2 party line, residence, $38; limited individual line service, business, 800 calls, $39; two party line service, business, 800 calls, $30; four party line service, residence, 500 calls, $25; four party line service, 800 calls, residence, $27.

It will be noted that the rates offered by the Utica Home Telephone Company are less than any rates offered by the Bell Company, party line service included.

The new telephone company is rapidly constructing a system of toll lines that will eventually put the local system in connection with service throughout the State and independent systems in general. The Utica Home Telephone Company has already erected a branch exchange at New Hartford, a suburban village, and operating 51 telephones at the present time. Franchises are being secured for other neighboring towns. The company has three No. 10 copper toll lines from Utica to Rome, four No. 10 copper toll lines from Utica to Ilion, Herkimer, Mohawk and Little Falls, two direct lines from Utica to Clinton and two from Utica to Waterville and one to New Berlin. This enables the Utica company to connect with all the independent systems in the State.

Ample provisions are thus made for immediate increase in the number of telephones to be installed, and the cable system is so designed that congested distributing points can be readily relieved and additional cables installed to care for additional business. The construction work was erected along the most recent and most modern plans, and nothing but first-class material was used. Particular attention was paid throughout to reducing the cost of maintenance to a minimum.

The switchboard installed in the central office is a relay multiple central energy switchboard of the latest design, having an ultimate frame capacity of 12,600 subscriber lines and equipped for the immediate operation of 2,400 independent lines. It has frequently been the case that telephone companies make insufficient provisions for future growth, but at this exchange very liberal provisions are made, both for future growth in the switchboard equipment, also for central office building requirements and corresponding growth of outside construction system.

The switchboard consists of 10 sections of 12,600 lines capacity switchboard frames, each of three operator's positions of the 9-panel type, both in the multiple, trunk and answering jack space. The first section is reserved exclusively for the handling of trunks both for local service as well as for trunks with neighboring exchanges, and is fully equipped with multiple jacks so as to enable the operators at this section to have complete access to the multiple.

Each of the three positions of the second to and including the

ninth section, are equipped with 100 subscriber line equipments, making a total of 2,400 line equipments. The first position of the tenth section is being utilized at the present time as a multiple annex position and is equipped with the necessary multiples for the proper operation of the third position of the ninth section.

Each equipped operator's position is provided with 100 lamp line signal line equipments. The corresponding keyboards are equipped with 15 pairs of cords with double lamp supervisory signals ringing and listening keys with associated apparatus, likewise an operator's telephone equipment complete, consisting of an operator's solid-back transmitter supported by means of flexible cords from an adjustable transmitter arm mounted on the upper part of the switchboard frame; an operator's head telephone and band attached to a plug, two operator's cut-in jacks, wired in multiple and provided with battery contacts for opening the operator's transmitter circuit when the plug is removed from either jack. The second jack is utilized for learning operators or other purposes as desired. Each position is further equipped with a line call pilot lamp, to light when calls are made on the respective positions; also a ringing supervisory pilot lamp, to light when the operator rings, indicating to the operator the condition of the line. If the line is open for any reason the ringing lamp fails to light.

Each finished section of switchboard is fully equipped at the present time with 2,400 multiple jacks, which are multipled in each section, thus enabling each operator to have complete access to all lines without passing cords in any position.

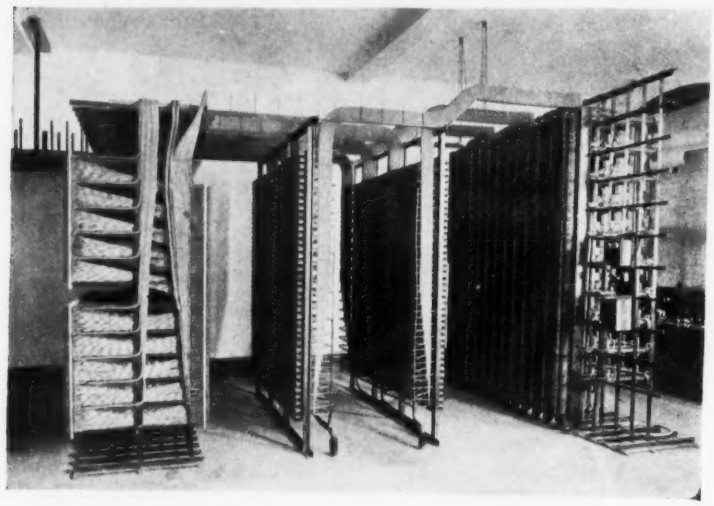


FIG. 2.—DISTRIBUTING FRAME, LIGHTNING ARRESTERS AND RELAY RACKS.

Each multiple jack is provided with individual tip and sleeve springs and thimble, all made of German silver of the best quality, with no contacts in any of the jacks, including the answering jacks. Provisions are made for increasing the number of multiple jacks in each section for an ultimate capacity of 12,600 lines, without in any way changing or altering the present installed cables. The multiple jacks are numbered in banks of 100 on the stile strips and arranged in rows of 20 each, each row of 20 being further divided by distinct vertical lines into groups of five to facilitate the selection of the individual jacks.

The answering jacks are mounted in strips of 10 with associated lamps immediately above the jacks. The lamps are provided with individual opals so as to enable access to be made to the individual lamps. The answering jacks are numbered by means of removable number plates, numbered to correspond with the subscriber lines as the subscriber lines may be located in any position of the switchboard so as to adjust the operator's loads by making cross connections on the intermediate distributing frame and not change the position of the corresponding multiple jacks.

The switchboard frames are made of structural steel assembled to form rigid frames; these frames are arranged in the form of a horseshoe, growing from left to right and so planned as to ultimately form an ellipse. The frames are covered with quarter-sawed oak, finished in golden oak with a piano polish and provided with hinged keyboards and made up of 5 layers of quarter-sawed oak, securely glued together to prevent warping. The plug boards are covered with belt leather. The front and rear panels are made removable so as to permit access to the interior of the board. The answering jack and multiple cable runs are built in the interior of the switchboard section so as to avoid the necessity of separate running boxes or using any troughs in the floors other than the ducts extending to the supervisory desks. The supervisory apparatus associated with the cord pairs is also mounted in the individual position and provided with the necessary battery bus-bars and other local terminals. All otherwise unfilled answering and multiple jack space is filled in with neat ebonized strips.

A supervisory desk consisting of a combination three-position chief operator's desk, trouble clerks and information clerk's desk, and a single position monitor's desk are provided in the central portion of the operating room. Each position of the chief operator's desk is equipped with local exchange lines, private lines connecting with the monitor's wire chief's and manager's desks, special incoming trunk lines from multiple switchboard, outgoing trunks terminating on plugs and cords and cords in the trunk position of the multiple board; also, the necessary connecting devices for answering incoming calls on the local lines and making calls on the outging trunks together with the necessary order wire keys and operator's equipments. Very complete and quick service is thereby gained as all inquiries are referred to this desk, thus enabling the subscriber operators to devote their attention to prompt answering of calls and completing connections.

The monitor's desk is equipped with jacks and associated lamps corresponding to each switchboard operator's position. The lamps are wired in multiple with the corresponding line call pilot lamps in the respective operating positions, thus indicating to the operator all incoming calls. The jacks are connected with a tertiary winding of individual operator's induction coils, thus enabling the monitor operator to listen in on any monitor circuit, without in any way indicating to the operators that they are being monitored. A corresponding monitor key is likewise installed, one for corresponding to each operator's position. There are likewise provided connecting cords, private lines to other desks and a limited number of exchange line connections, together with an operator's complete telephone equipment. These desks are made of quarter-sawed oak, finished to correspond with the main switchboard and consist of flat-top desks with turrets on top for mounting thereon the necessary apparatus and so designed that the operators seated at these desks can readily look over the top of the turrets and have ocular supervision of the operators and thus maintain perfect discipline in the operating room, which is so essential to good operating.

The operating room is located on the second floor of the telephone building, well lighted, both from one side and the end of the building and also by means of skylights with suitable shades so as to get proper illumination in the room, without, however, interfering with the prompt detection of the lighting of the line lamps in the operator's positions. The operating room is also artificially lighted by incandescent lamps. The switchboard is illuminated by means of incandescent lamps mounted on brackets on the switchboard and provided with shades so adjusted as to throw the light on the multiple space of the switchboard section and shading the necessary jack space. The alternate lamps are connected on two independent circuits controlled by switches.

The operator's quarters are provided in the front quarter of the second floor with suitable locker, recreation and toilet rooms. The recreation room is very neatly furnished for the comfort of the operators when off duty. The operators' hours are so arranged that they are allowed recesses in order to rest or partake of lunches as they desire, their places at the board being taken by relief operators.

The terminal apparatus and power apparatus is mounted in the rear of the first floor, the front portion being used for long-distance toll room, general offices and private offices. The terminal racks consist of combination main, relay and intermediate distributing frames made up in sections of 800 capacity each and so designed that there may be added additional sections as may be required in sections of 800 capacity each. The main distributing frame is equipped with Cook combination carbon and sneak current lightning arresters in strips of 200 pairs each and provided with terminal strips made of rubber with terminal clips, 25 pairs each mounted on shelves. Flame-proof jumper wire is used for connecting any pair of cable terminals with any pair of lightning arrester terminals. The street cables are carried through the basement from the underground system on cable racks and terminate on the terminal side of the main distributing frame, leaded switchboard cable being spliced directly into the underground cables. The lead sheath is cut off the cable above the floor line so as to enable the cables to be fanned out to the respective terminal strips. The terminal strips are numbered to correspond with the cable pairs in the underground system.

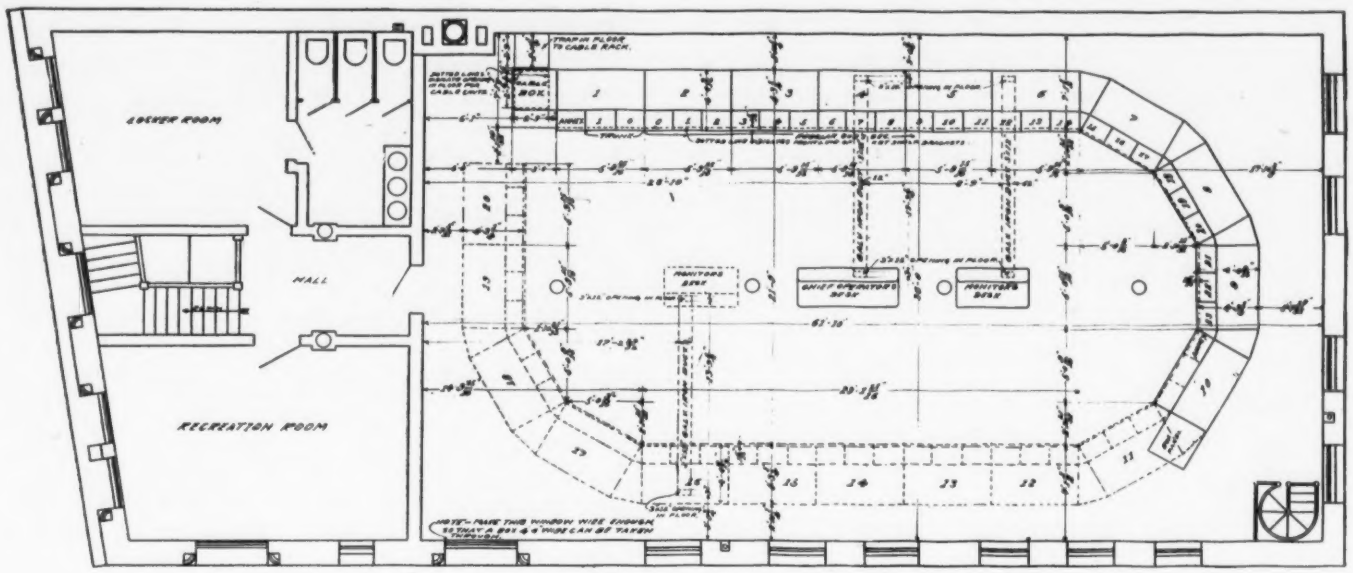


FIG. 3.—SECOND FLOOR PLAN.

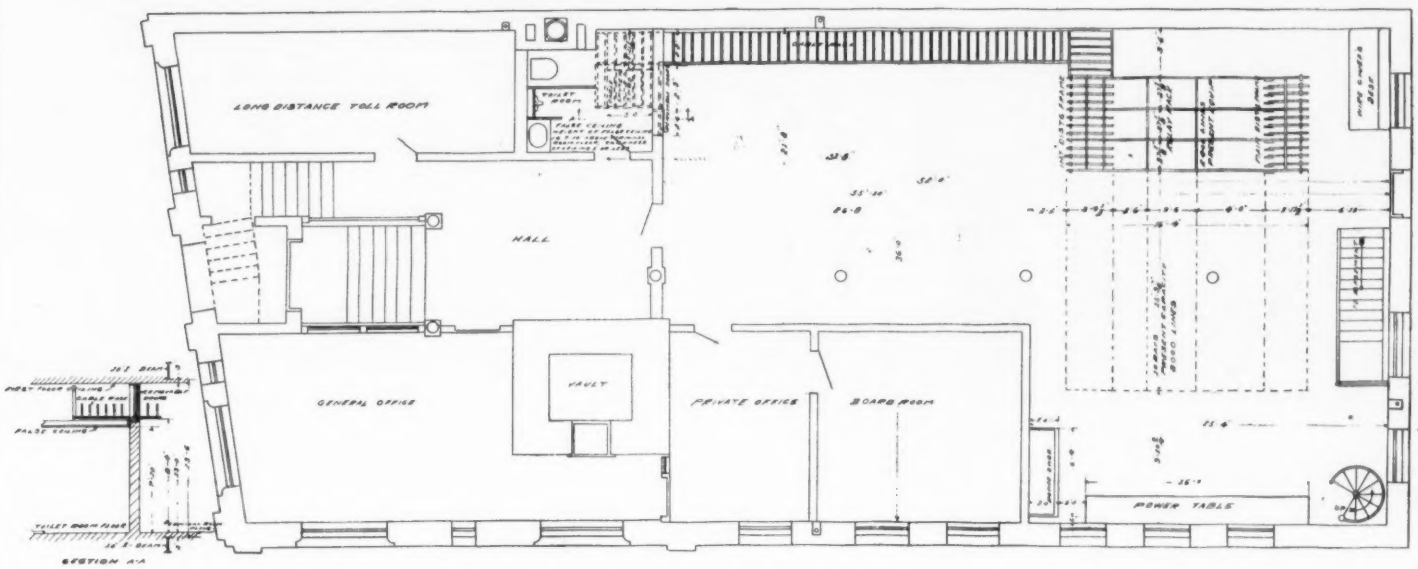


FIG. 4.—FIRST FLOOR PLAN.

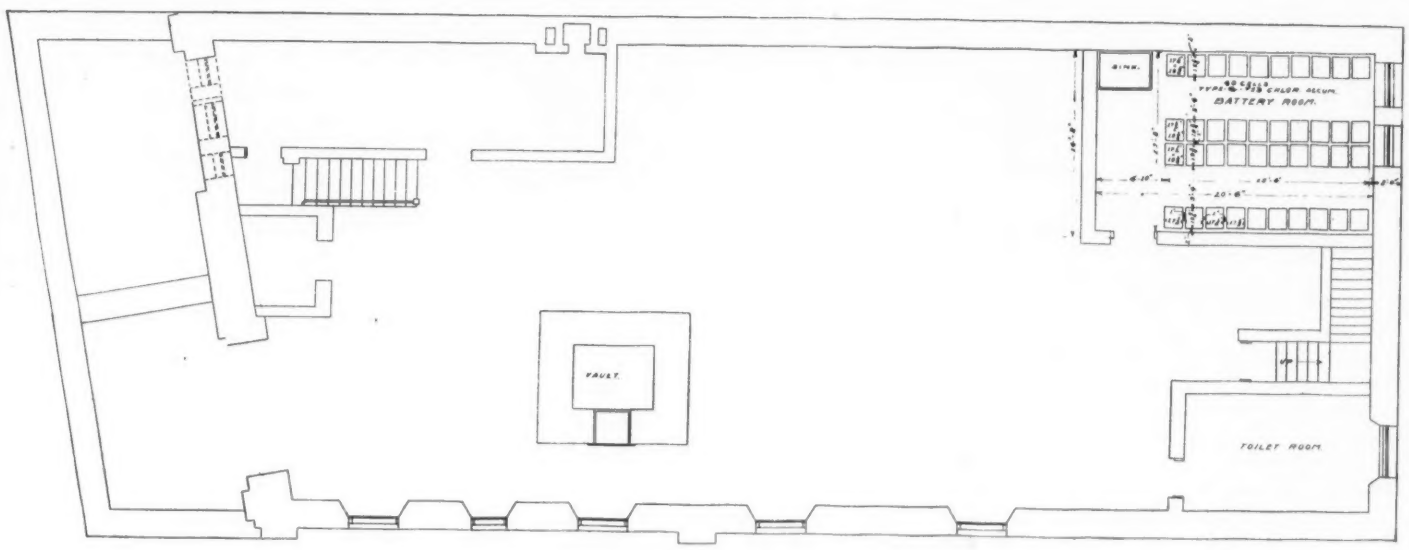


FIG. 5.—BASEMENT FLOOR PLAN.

UTICA HOME TELEPHONE COMPANY'S EXCHANGE.

From the lightning arrester side of the main distributing frame are carried switchboard cables to relay rack and from relays mounted thereon to the intermediate distributing frame. The intermediate distributing frame are likewise provided with a set of terminals on each side to facilitate cross connections. The terminals on these frames are also mounted on rubber strips.

The multiple cables are carried from the multiple side of the main distributing frame on an overhead cable rack to the first setion of the multiple switchboard, utilizing 100-pair cable for compactness and providing individual cables for each run of 100 multiple lines. The answering jack cables are similarly carried on the cable rack to the respective operator's positions. All cables are carried overhead, thus avoiding the laying of any cables on the floors which might otherwise render them subject to damage due to accidents or floods, the insulation of the cable is thus unimpaired in any manner.

A two-position wire chief's desk is provided accessible in position to the terminal apparatus and power apparatus. This wire chief's desk is of the same design as the supervisory desks and provided with exchange lines, incoming trunk lines from multiple switchboard, outgoing trunks terminating on the "B" position of the multiple board. The test lines terminate on plugs on the main distributing frame, enabling the wire chief to test any pair of conductors out in underground cables, or bridge his apparatus across the lines

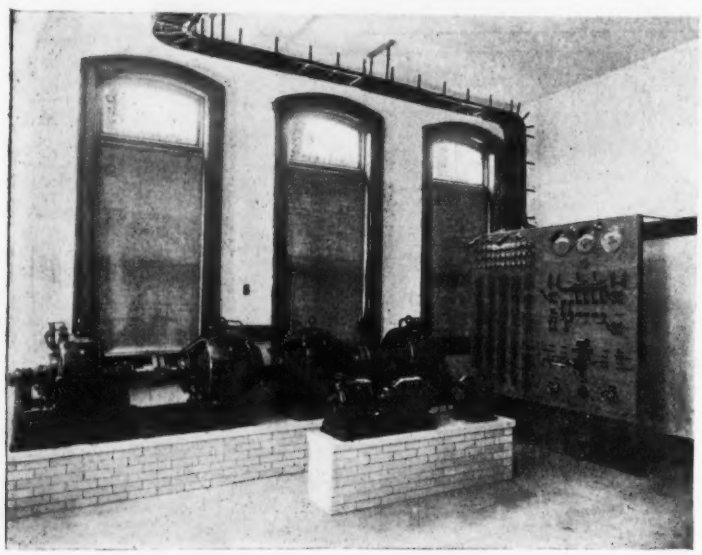


FIG. 6.—CHARGING MACHINES.

under test. He is provided with special cords for making all necessary tests of grounds, condenser crosses and reverses, utilizing a portable voltammeter in connection with the main 40-volt storage battery.

The power apparatus consists of a two-panel pink Tennessee marble power board having mounted thereon two Weston flush type direct-current ammeters, one to indicate the discharge and the other to indicate the charge of the storage battery; one Weston flush type double-scale voltmeter; one Crouse-Hinds 6-circuit voltmeter switch, one series overload and underload circuit-breaker, all necessary switches for the operation of the power board suitably provided with designation plates, back-connected rheostats and starting boxes with wheel handles and index plates, and bus-bars.

Terminals are also provided for each battery lead to the multiple switchboard and also ringing generator lamps with fuses for the ringing generator leads. The power board is well illuminated by means of brackets and incandescent lamps.

The charging machines used for charging the storage batteries consist of two Wagner alternating-current motors direct-connected to Roth generators, each machine having capacity for charging the storage batteries at their ultimate charging rate. One direct-connected Wagner alternating-current motor and Roth self-excited ringing generator, and a direct-current Roth ringing dynamotor for operation from the storage battery are used for ringing purposes, each of the ringers being provided with howler, busy back and periodic attachments. The machines are substantially mounted on brick piers with white enameled finish and hard wood tops. All concealed wiring is in iron-armored conduits laid in the tile floors.

The storage battery plant consists of two sets of 20 chloride cells in lead-lined tanks having an ultimate tank capacity for 1,200 lines and equipped with the necessary elements for the immediate operation of 3,000 lines. The storage batteries are installed in the rear of the basement in rows of 10 cells each, ample space being provided for the proper inspection of the individual cells.

All power for signaling, talking and the operation of the supervisory lamps is furnished from the main central office storage battery, which is equipped in duplicate and further provided with duplicate ringing and charging machines.

The calling is automatic. By the simple raising of the receiver from the hook, the subscriber lights the line lamp. The operator in putting up the connection utilizes two lamps per pair of cords, each indicating the operation of the telephone with which it is connected. When the subscribers finish their conversation, the corresponding lamps in the cord circuits light, indicating to the operator to disconnect. There is no occasion for the operator to listen in on connections, as she is only required to listen in while answering the subscriber. The pilot lamp system is multipled in the monitor's desk, enabling the operator to supervise the service of the individual operators. The monitor operator is thus kept in complete touch with the operation of the switchboard. A night bell system is provided for operation at night when the service is light, so as to attract the night operator's attention as soon as the calls are made.

All central office apparatus was furnished and installed complete by the Stromberg-Carlson Telephone Manufacturing Company, of Rochester, N. Y., and Chicago, Ill., including the telephones, under the plans and specifications compiled by Mr. W. C. Polk, engineer of the Central Telephone Construction Company, which company constructed the system complete.

The Utica Home Telephone Company is now in operation under the management of Mr. C. H. Poole, secretary and general manager, with Mr. James S. Brailey, Jr., general manager, and Mr. W. C. Polk, engineer, assisted by Mr. Samuel Fraser and Mr. Edw. L. Cline, who has since been appointed superintendent of construction for the local company.

Plotting of Speed Time Curve From the Acceleration Speed Curve.

BY L. A. FREUDENBERGER.

FROM the performance curves of a motor, knowing the train resistance at various speeds, the curve showing the relation between speed and acceleration may be plotted.*

Thus, the acceleration, $\frac{dv}{dt}$, corresponding to various speeds, v, is known. It is required to find the speed, v, corresponding to various time values, t.

$$a = \frac{dv}{dt}. \quad dt = \frac{1}{a} . dv. \quad \int dt = \int \frac{1}{a} . dv. \; t = \int \frac{1}{a} . dv.$$

Hence if values of $\frac{1}{a}$ are plotted on a base of speed, the area included between the curve and the speed base will represent time values corresponding to different speeds. Areas may be measured by means of a planimeter or an integraph. Thus time values corresponding to different speed values are known, and the speed time curve may be plotted. By integrating the area included between the speed time curve and the time base, the distance time curve may be plotted in the usual manner.

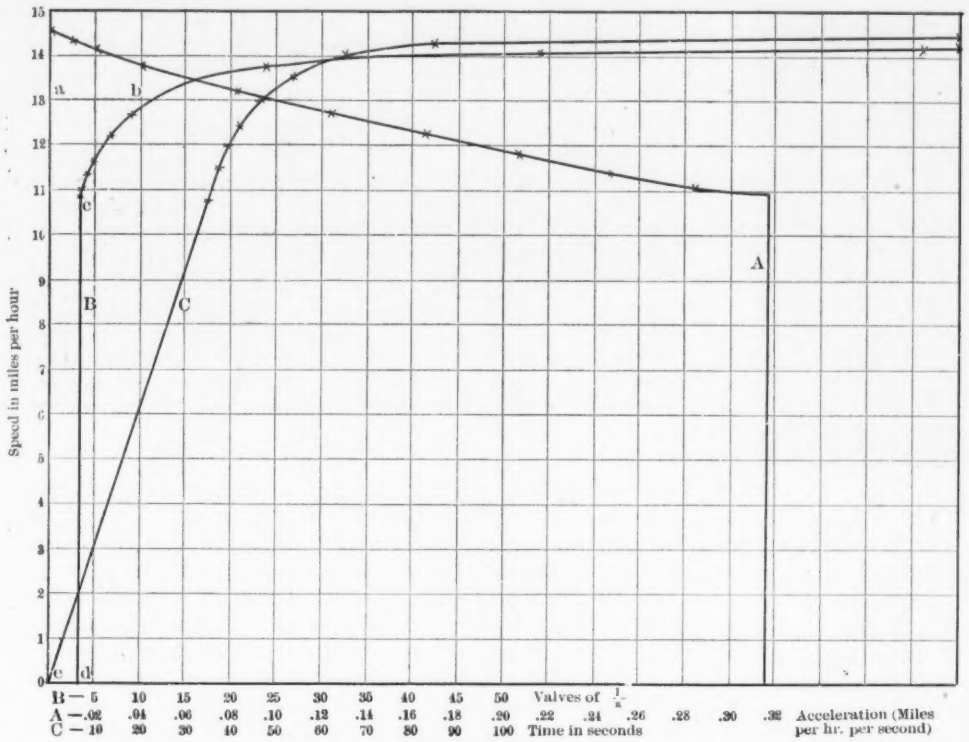
In the figure let A represent an acceleration speed curve which to a different scale of abscissæ will represent the resultant torque speed curve.† The acceleration remains constant at 0.316 miles per hour per second until a speed of 10.9 miles per hour is reached, when the acceleration rapidly diminishes and becomes zero when a constant speed of 14.45 miles per hour is reached.

* See "Notes on the Plotting of Speed Time Curves," by C. O. Mailloux. Transactions of American Institute of Electrical Engineers, vol. 19.

† The resultant torque speed curve was taken from C. A. Carus Wilson's "The Direct Current Motor," page 163.

In curve *B*, abscissæ represent values of $\frac{1}{a}$ and ordinates the corresponding speeds. The area *a b c d e*, for instance, represents a time value (45.9 seconds) corresponding to a speed of 13.0 miles per hour. Thus a number of points on the speed time curve may be determined sufficient to plot the speed time curve, *C*.

The curves are based on data of two series-wound motors permanently connected in series, the armatures being directly on the axles without gearing. The resistance of each motor was .387 ohm; line voltage, 400; wheel diameter, 27 in.; weight of train, 35 tons of 2,240 pounds; maximum current per motor, 150 amp.; frictional torque assumed constant at 5,760 inch-pounds.


Speed in miles per hour
a
b
c
d
e
A
B
C
B — 5 10 15 20 25 30 35 40 45 50 Valves of 1/a
A — .02 .04 .06 .08 .10 .12 .14 .16 .18 .20 .22 .24 .26 .28 .30 .32 Acceleration (Miles per hr. per second)
C — 10 20 30 40 50 60 70 80 90 100 Time in seconds

SPEED TIME CURVES.

Why the Disc of an Induction Wattmeter Rotates, and Why the Torque on the Disc Varies With the Watts of the Load Which the Meter Records.

BY T. W. VARLEY.

IN Fig. 1, *O A* is the direction of the applied volts upon the load. For a power factor of 1.00, this would also be the direction of the load current. The applied volts cause a current to flow in the potential circuit of the wattmeter, which lags some 82° behind the volts, as *O B*. This current sets up a magnetic field and causes lines of force to cross the disc of the wattmeter. It is these "lines" which are made to lag 90° behind the applied volts as *O C*. One way of causing this is to partially bridge the poles of the shunt or potential magnets. The lines of force crossing the disc are thus caused to lag behind these of the bridge shunt, the lagging being adjusted to be 90° behind the applied volts.

The lines of force crossing the disc set up e.m.f. circles in the disc, 90° behind them, as *O D*. As the disc resistance is non-inductive, these e.m.f. circles set up circles of current in step with the e.m.f. circles, or 90° behind the magnetism, caused by the potential, or in step with the applied volts, and of opposite sign. The opposite sign is of no consequence as it only affects the way the disc shall rotate in the original design. The currents in the disc now look as in Fig. II.

Notice that the currents are in opposite direction. The disc does not rotate as yet, for there is no field to give it torque. This is all that takes place from the potential effect.

The volts applied to the load are in the direction *O A*, and for a load P.F. of 1.00, the current being also in the direction *O A*, there is set up a magnetic field in step, or in the same direction, *O A*.

These lines cross the disc, setting up circles of e.m.f. 90° behind, or in the direction of *O C*. These circles of e.m.f. set up circles of current in step, or in the same direction, *O C*. The currents are as in Fig. 3. Notice that the currents are between those caused by the potential of Fig. 2.

To return to Fig. 1, the disc currents caused by the potential are in step with the magnetic "lines" through the disc, caused by the load current and as they are out of position with respect to each other, one set will repel and the other attract, so that the disc will receive a torque or pull in a certain direction as in Fig. 4. This torque will vary as the product of the disc currents and the "lines" through the disc, and as these effects are caused, respectively, by the potential of load and current of load, the torque will vary as the watts of the load. If this were all the torque would come in impulses, one for each alternation.

Return again to Fig. 1 and notice that 90° later than the action mentioned above another action takes place. The disc currents are now caused by the load current and are in step with the "lines" caused by the potential, or of the opposite conditions to that of the first as in Fig. 5. The disc will be rotated in the same direction as before and the torque will again vary as the watts of the load. Thus the disc will experience two pulls, one 90° behind the other and each of which blends into the other, so that its torque will not be in impulses, but of a uniform nature.

180° behind *O A*, the reverse action takes place to that first mentioned as in Fig. 6. The pull still being in the same direction. At 270° behind *O A* the last action takes place as in Fig. 7. The pull is still in the same direction. This brings us around to *O A* again, where all is repeated or the cycle of operation ends.

To show the necessity of lagging the magnetic lines through the disc, caused by the potential to 90° behind the potential. Any slight divergence from the 90° position causes the meter, which is made correct for unity power factor, to be "out" on other power factors.

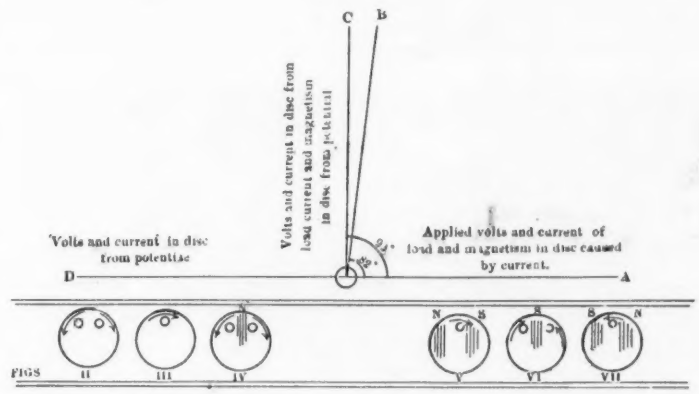

C
B
Volts and current in disc from potential
Volts and current in disc from load current and magnetism in disc from potential
Applied volts and current of load and magnetism in disc caused by current.
D
A
FIGS II III IV V VI VII

DIAGRAM OF WATTMETER DISC ROTATIONS.

For instance, if the magnetism lags 5° over the 90° position and the meter is made correct for that position, which means making it 4 per cent. faster, then it would be 14.2 per cent. fast at a load P.F. of .50. If it leads 5° under the 90° position, then for the same P.F. of .50, it would be 17.8 per cent. slow.

Any lag of the load current behind the applied volts, causes a lag of the magnetism through the disc (from the effect of the load current) to lag behind *O A*, the applied volts a similar amount 90° later, the currents in the disc (from the effect of the load current) are lagged an equal angle behind the magnetism through the disc, from the effect of the applied volts. Thus the meter torque varies as the power factor of the load.

Gold Pan Mining Plant at Breckenridge, Colo.

Breckenridge, Colo., is a growing mining town with a population of about 1,000, located 110 miles west of Denver, and practically in the center of the State. Here the Gold Pan Engineering & Mining Supply Company has recently entered quite extensively into placer

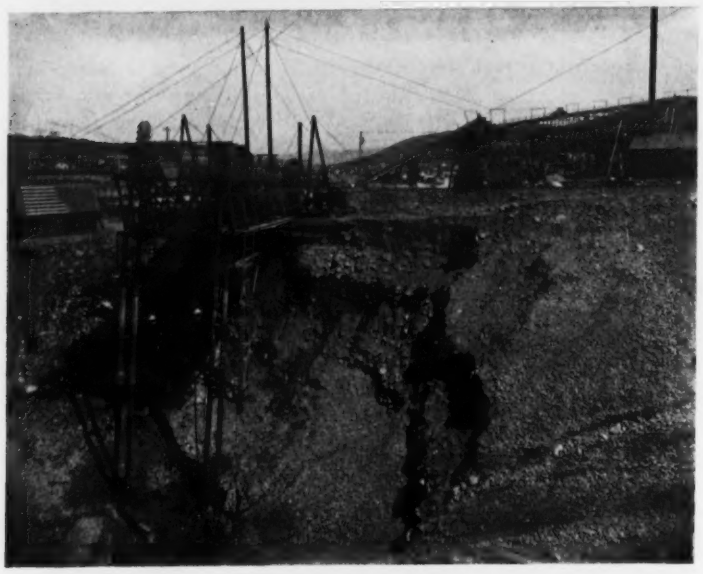


FIG. 1.—PLACER MINE AT BRECKENRIDGE, COLO.

mining and is probably operating the largest placer mine in Colorado. The center of the company's operations at present is shown in Fig. 1. In the foreground are seen two sets of vertical water pipes, which act as hydraulic elevators for raising the sand and rock to the flumes above. Water under high pressure is forced down one pipe and drawn up the other. The two ends are moved around wherever desired and the sand is drawn up with the water. These vertical pipes at present are 80 ft. long. They discharge into wooden flumes and the material is carried along over the "riffles" where the gold is separated and taken out. The rocks and refuse sand are carried away and dumped by means of the conveyor and trestle seen at the right.

The Gold Pan Company is now installing a 150-hp induction motor in the pit shown in Fig. 1. This motor will drive a centrifugal pump to assist the hydraulic elevator in keeping the working free from surplus water. In order to handle large rocks and carry them out of the way two portable cranes of the boom type will be installed. These cranes will run on tracks and each will be operated

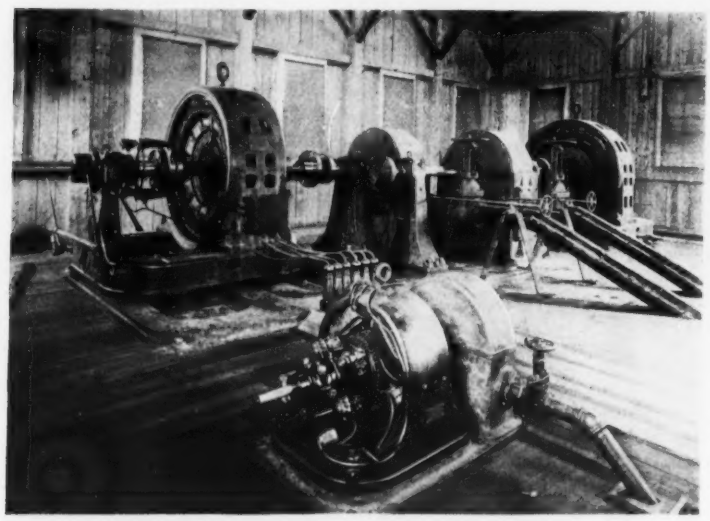


FIG. 2.—POWER STATION ON SPRUCE CREEK.

by a 30-hp Westinghouse induction motor mounted directly on the crane. Current will be supplied to the motors through flexible cables.

The power plant which supplies power for these motors is located on Spruce Creek, about five miles distant from the mine. Water is brought to the power house through an open canal for about a mile to a hill back of the station and then carried to the water wheels through steel pipe. The effective head under which the wheels operate is 425 ft.

An interior view of the generating station is given in Fig. 2. There are two main water wheels of the Pelton type, each direct-connected through shafting to a 200-kw Westinghouse revolving field two-phase, 440-volt alternator. The arrangement of water wheels and generators is a novel and ingenious one, in that it provides a flexible means of connecting each generator to either wheel. The shafts of the wheels are parallel and are carried out with a coupling on each end. The shafts of the generators are normally connected to the Pelton wheel shafts in the manner indicated in the sketch, Fig. 3. Each generator is mounted on an extension foundation and is provided with a special moving lever (shown on one machine at the left in Fig. 2), so that it can be quickly moved from its normal position into alignment with the other waterwheel shaft and coupled up for operation. In this way both generators can be driven from either water wheel, and also each generator may be driven independently by either of the water wheels. In event of accident to

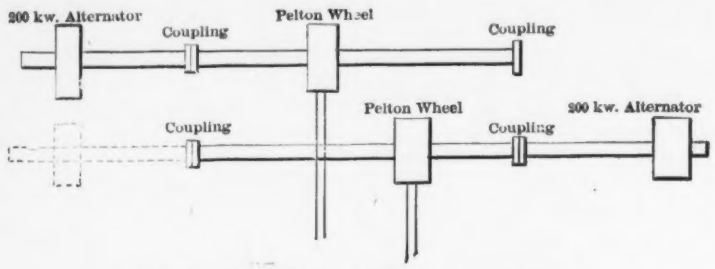


FIG. 3.—DIAGRAM OF METHOD OF COUPLING.

either pipe line or to a water wheel or generator this flexible arrangement will undoubtedly be found of considerable value.

For supplying exciting current there are installed two 11-kw, 125-volt exciters, each directly driven by a separate Pelton water wheel. One of these exciters is shown in the foreground in Fig. 2. This pitcture also illustrates the method of carrying flexible leads from the generator to a row of insulating blocks from which the wires run in a covered box to the switchboard. The flexibility of these leads allows the generator to be moved from one position to the other without disconnecting any wires.

Each water wheel has a gate valve controlling the flow of water, but no automatic regulator is provided. The speed of the wheels is varied by means of the hand wheels at the end of long rods, which may be seen in the picture. These rods serve to raise or lower a hood

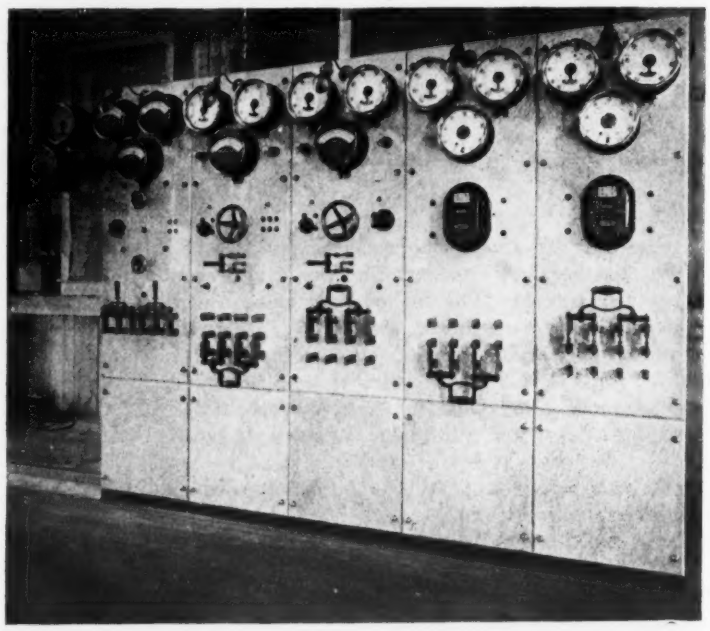


FIG. 4.—SWITCHBOARD IN POWER STATION.

in front of the nozzle, thus varying the direction and quantity of the water discharged. The nozzles are not of the deflecting type, such as are used on larger wheels.

The station switchboard shown in Fig. 4 is built of blue Vermont marble and consists of five panels. The left-hand panel contains switches and instruments for both exciters. Panels 2 and 3 control

the two generators, each being provided with two alternating-current ammeters, one direct-current ammeter, field rheostat and main generator switch. The remaining two panels control the two feeder lines leading to the transformers. Each panel is equipped with two ammeters, an indicating wattmeter, a polyphase integrating wattmeter and a four-pole, double-throw switch. Wattmeters of the

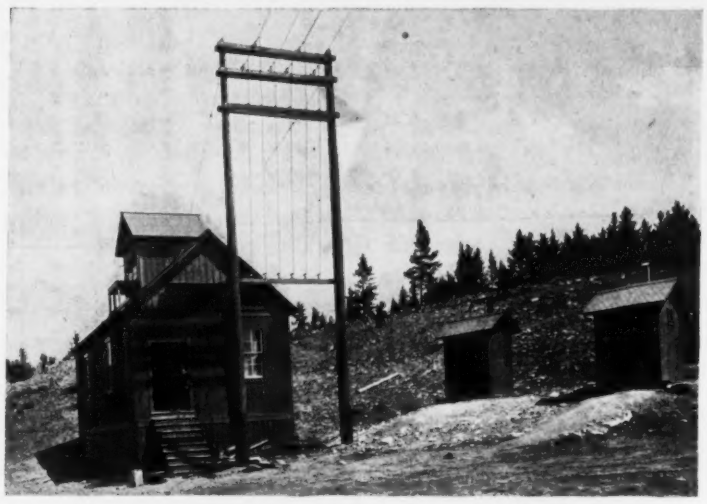


FIG. 5.—BRECKENRIDGE TRANSFORMER SUB-STATION.

indicating and integrating types are used, as the company sells a good deal of its current for power and lighting and the registrations are necessary in keeping the accounts of the customers. The switchboard has a double set of bus-bars so that the lighting and power loads, which are controlled from separate panels, may be thrown on either generator. At the left of the board on a swinging bracket are mounted voltmeters and a frequency meter.

The two 440-volt, two-phase circuits are carried from the switchboard to the transformer room, located in a separate but adjacent building, where four 100-kw oil-cooled single-phase transformers

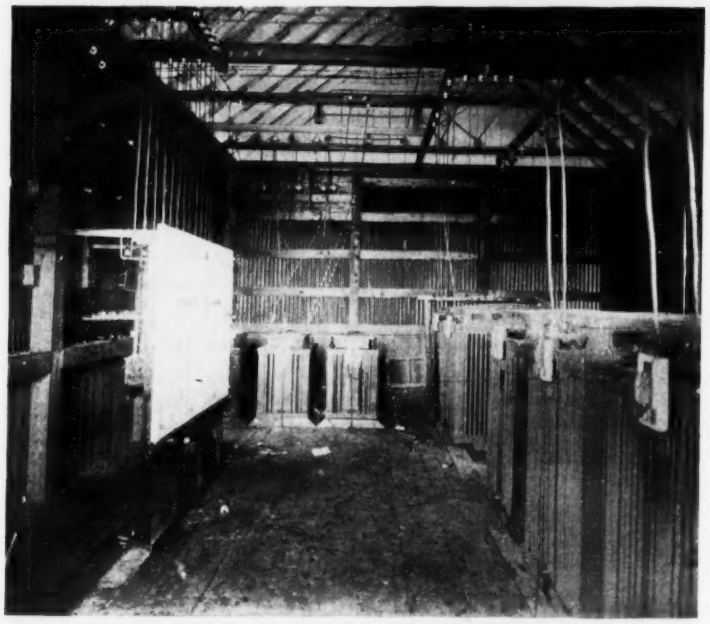


FIG. 6.—INTERIOR OF BRECKENRIDGE TRANSFORMER SUB-STATION.

raise the potential to 10,000 volts, three-phase, for transmission to a sub-station in the town of Breckenridge, five miles distant. The transmission wires are of No. 5 bare copper and are mounted on Mershon triple-petticoat glass insulators. The sub-station is shown in Fig. 5, the two three-phase, 10,000-volt circuits coming into the building at the right and the three four-wire, two-phase circuits leaving at the left. The transformer equipment in the sub-station, shown in Fig. 6, consists of five 100-kw oil-cooled transformers (one for reserve) used in stepping the 10,000-volt current down to two circuits at 2,000 and 440 volts. There are also three 25-kw transformers (one being in reserve) for supplying a 2,000-volt circuit for lighting. The company has a franchise for lighting the streets of the town with incandescents and also supplies a commercial incandescent service, the distribution being at 110 volts. Enclosed arcs are also supplied for commercial lighting and are used in lighting the pit and grounds of the Gold Pan Company, as the mining operations are carried on continuously day and night. The 2,000-volt and the 440-volt circuits from the 100-kw transformers are used for the company's own power and also for customers in the vicinity, the power being used chiefly in lode mines for driving compressors, hoists, etc. Type C Westinghouse induction two-phase motors are used throughout. One 50-kw motor is used to drive the company's own machine shop where the hydraulic pipe used in the mining operations is manufactured.

The tail water from the power plant is carried down to the mine and is there used by the company for the hydraulic elevators.

As the placer mining operations cannot be carried on during the winter months on account of the snow and the freezing of the water, the water power plant is shut down and a relay steam plant located at the mine is called into service for supplying the lighting load in Breckenridge. This plant consists of two 50-kw, 2,000-volt, two-phase Westinghouse alternators driven from a line shaft by means of a Corliss engine.

The water wheels at the power station were manufactured by the Pelton Water Wheel Company, of San Francisco, and all the electrical equipment was furnished by the Westinghouse Electric & Manufacturing Company, through its Denver office. Credit for the design of the power station and the other electrical equipment and the installation of all the plant is due to George H. Evans, engineer and manager of the Gold Pan Engineering & Mining Supply Company.

"Aerial Electric Ladder" Experiments.

In our last issue reference was made to the proposed experimental tests of the "electric ladder," invented by Mr. Albert Gallatin Whitney, of Chicago. We have since received from a correspondent some details of a coming experiment and its object. Mr. F. X. Schoonmaker has charge of the work and he is now in Colorado examining the principal mountain peaks in that State with a view to the selection of one on which the experiments may be conducted.

The "electric ladder" is stated to be a combination, in proper proportions, of copper, steel and silver spheres, connected by wires, which it is planned to project from the earth, or, to use the inventor's words, to "let fall out" of the atmosphere into the ether. Mr. Whitney believes that the planets and other bodies of matter in the universe are immersed in seas of electricity, and that the orbits and motions of the planets and other members of the universe are caused by currents in these seas of electricity. So, by projecting a conductor connected with a magnetizable receiving apparatus from the earth's surface, he figures that the earth's atmosphere may be pierced and that the great force of electricity beyond will pull the receiver away from the earth and hold it there, thus affording through the conductor a supply of electricity that may be used for commercial purposes.

The inventor is taking out a number of patents on his "electric ladder." He bases his invention largely on a personal theory of matter and claims that the Newtonian theory of gravitation is incorrect when applied to bodies outside of the earth's atmosphere. He asserts that the French Academy of Sciences and also the higher authorities in the German Patent Office have accepted these new theories after careful and full investigation.

Mr. Schoonmaker states that a private test of the Whitney electric ladder has been made on a small scale in New Mexico and that it was successful, incandescent lamps being lighted by the electricity brought down from the electrical ether. The object of securing a mountain peak in Colorado for further operations is that the mountain tops there are all attained with comparative ease, and the atmospheric conditions at the altitudes reached are such that men can stay there continuously if necessary without any serious effects.

Pike's Peak is favored by Mr. Schoonmaker for the reason that it has a railroad running to its summit. The method of projecting the conductors and receivers into the ether has not been disclosed as yet. Some years ago the same inventor issued a pamphlet describing a similar means of obtaining electricity from nothing by a "combination of spheres," the pamphlet containing a portrait and highly eulogistic personal sketch.

Brake Horse Power and Efficiency of a Small Motor.

BY J. L. DICKSON.

HAVING had occasion some time ago to measure the brake horse-power and efficiency of a small motor, it has occurred to me that an account of the method might be of some interest to your readers.

The apparatus used was a standard ammeter, a voltmeter, a speed counter, a prony brake, a resistance box and current from a direct-current dynamo. The accompanying diagram shows just how the apparatus was set up. *M* represents the motor, *A M* the ammeter,

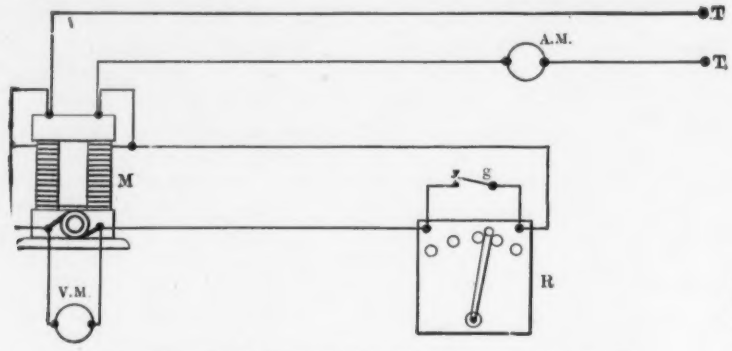


FIG. 1.—DIAGRAM SHOWING ARRANGEMENT OF APPARATUS.

V M the voltmeter, *T T* the terminals, which were connected to the mains of a direct-current dynamo, *R* the rheostat and *S* a switch cutting out the last resistance of the rheostat.

The prony brake, which is not shown in the diagram, consisted of a leather strap held in place over the belt pulley by means of two cords, which in turn were fastened to two spring balances, the object of the balances being to measure the pull on each side of the pulley; the balances were fastened to a bracket, which was attached to the wall.

The input was determined from the current supplied, as measured by the ammeter, and the voltage at the brushes of the motor as indicated by the voltmeter. The output was determined from the pull of the brake, circumference of the pulley, and the revolutions per minute. The circumference of the pulley measured 11 in. The

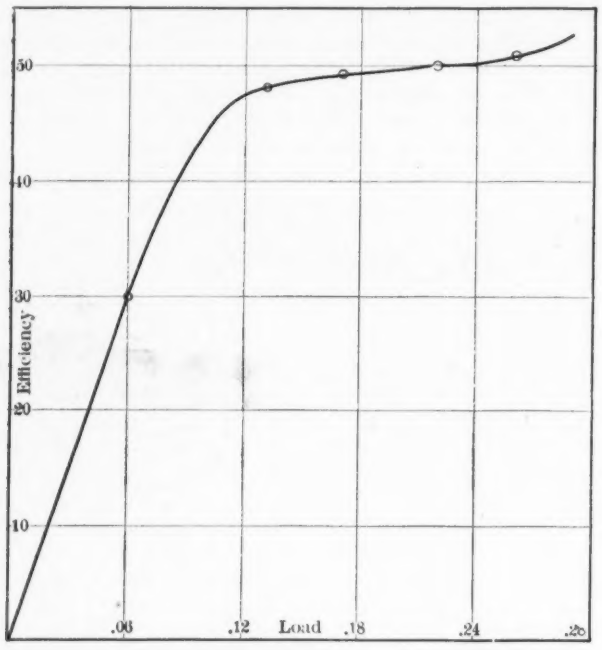


FIG. 2.—CURVE SHOWING RELATION BETWEEN LOAD AND EFFICIENCY.

input and output were determined for various loads, as shown in the following table:

Reading.	Volts.	Amperes.	Balance B_1	Balance. B_2	R.P.M.
I	115	1.4	1 lb.	1 oz.	2470
II	114	1.8	2 lb.	1 oz.	2480
III	111	2.4	3 lb.	1 oz.	2130
IV	115	2.9	4 lb.	1 oz.	2012
V	115	3.4	5 lb.	1 oz.	1890

The input in horse-power is the number of watts divided by 746, or for reading I. was $\frac{115 \times 1.4}{746} = .20$ hp. The output is the number of foot-pounds divided by 33,000, or $\frac{11 \times 1 \times 2{,}470}{12 \times 33{,}000} = .06$ hp. The efficiency is the ratio of the output to the input, or $\frac{.06}{.20} = .30$, or 30 per cent.

The input, output and efficiency of the other four readings were calculated in the same manner, and the results are given in the following table:

Reading.	Input.	Output.	Efficiency.
I	.20-H.P.	.06-H.P.	30%
II	.27-H.P.	.13-H.P.	48%
III	.35-H.P.	.17-H.P.	49%
IV	.44-H.P.	.22-H.P.	50%
V	.51-H.P.	.26-H.P.	51%

From the above data a curve was plotted showing relation between efficiency and load, using per cent. efficiency as ordinates and load in horse-power as abscissæ. This curve shows that as the load increases the efficiency becomes greater; it also shows that the motor is doing better work when the load is greater.

The above is a rapid and neat method of obtaining the brake horse-power and efficiency of a motor for various loads.

The Pollak-Virag Rapid Telegraph.

At a general meeting of the Hungarian Academy of Sciences at Budapest on May 6, 1903, the Wahrmann prize of 2,000 kronen was

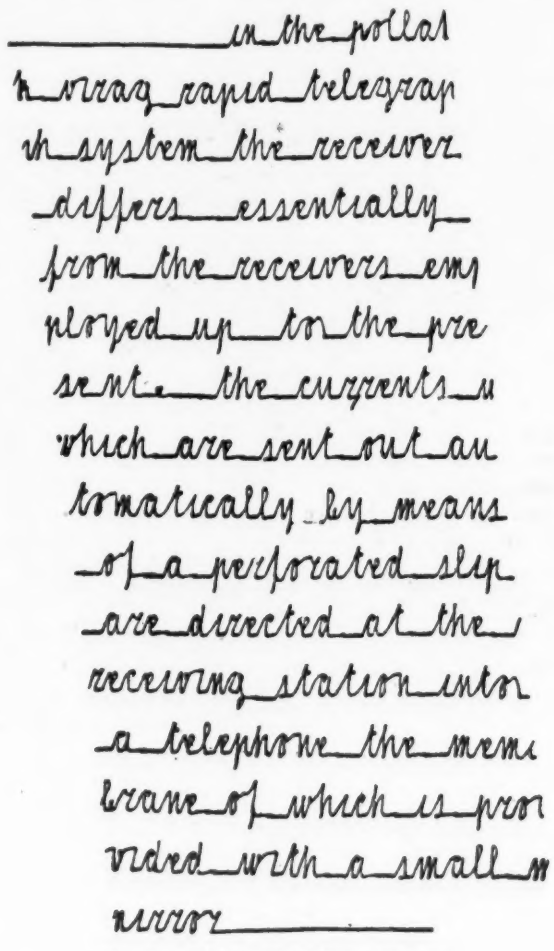


FIG. 1.—FORM OF RECEIVED MESSAGE.

awarded to the inventors of the Pollak-Virag Rapid Telegraph. A complete description of this system apeared in our columns several years ago, and it suffices to say here that in its latest form it is a writing telegraph requiring the use of two wires and a ground.

Fig. 2 is a fac simile of the transmitting tape and of the message as received. The upper row of dots corresponds to impulses sent over one line and the lower impulses sent over the second line. The first mentioned impulses act upon a diaphragm to give a vertical motion to a mirror and the second set act to give a horizontal motion. A pencil of light striking the mirror is thus given a motion compounded of the aforesaid horizontal and vertical motions, and when this pencil strikes a sensitized strip of photographic paper, the trace consists of the italic characters shown in the lower part of the cut. Fig. 1 is a reproduction of a message as received by the system.

It is claimed that 45,000 words per hour can be transmitted with this system as against 12,000 words by the Hughes typewriting system, and 18,000 by the Wheatstone rapid system. A perforating

FIG. 2.—FAC SIMILE OF TRANSMITTING TAPE.

operator can perforate 2,000 words hourly, so that one set of rapid telegraph apparatus will keep 23 perforating machines at work. The inventors have been successful in constructing a photographic arrangement whereby the development requires only from five to six seconds and the fixing from six to seven seconds, at the end of which time the telegram comes out of the apparatus ready for delivery in the form shown in Fig. 1.

In official reports of experiments on Hungarian State telegraph lines, it is stated that messages were dispatched between stations 120 miles apart at the rate of 45,000 words per hour. In another experiment, the largest number of words transmitted was about 40,000 in an hour. The head of the Hungarian Postal Telegraph Department, in his report, regretted that the system could not be applied in Hungary, for the reason that there is not enough telegraphic service to provide sufficient work even for a short time for a rapid telegraph system. At present the system is being regularly worked over a line between Berlin and Frankfort, Germany, a distance of 360 miles.

Of the money prize awarded, one-half is to go to the widow of the late A. Pollak, whose family was left in straitened circumstances.

Recent Electrochemical Developments.

ELECTRIC FURNACE.

A patent was granted on July 7th to Mr. P. L. T. Héroult, of La Praz, France, who is best known as the inventor of the Héroult aluminium process (which is quite similar to the Hall process) but whose main activity in recent years has been in the electrometallurgy of iron and steel. The furnace shown in the adjoining diagram is especially intended for the production of cast-iron, ferrosilicon, ferromanganese. This reduction furnace is to be operated in connection with a preparatory furnace in which the ores to be treated are previously fused or sufficiently softened to descend progressively along the passage, *A*, to the point *e*, whence they fall into the well, *C*, of the furnace, where the reduction takes place. This well contains a column of coke, *Z*, through which the electric current passes, and with which the fused or pasty ore becomes mixed when it comes from the adjoining preparatory furnace.

As the coke is used up in reducing the ore, the coke column is fed at the top from a reserve contained in the upper part of the furnace. The current enters the furnace, through the carbon block, *G*, and leaves it through the crucible, *B*. This crucible has a tap-hole, *D*, for issue of the molten metal, and through the wall is a hole, *E*, for issue of the slag. The hot gases developed during reduction ascend and pass out between *e* and *h* into the preparatory furnace, where their heat is utilized.

The block, *F*, is called by the inventor a "false electrode"; it acts as an intermediate of bi-polar electrode, the current passing from *G* to *e*, through *F*, and from *f* to *B*. At the points *e* and *f* an intense heat is therefore developed and it is at these points where the heat is needed. The contacts through which the current enters and leaves the furnace are sufficiently remote from these points of highest temperature.

PLATING IRON WITH ZINC.

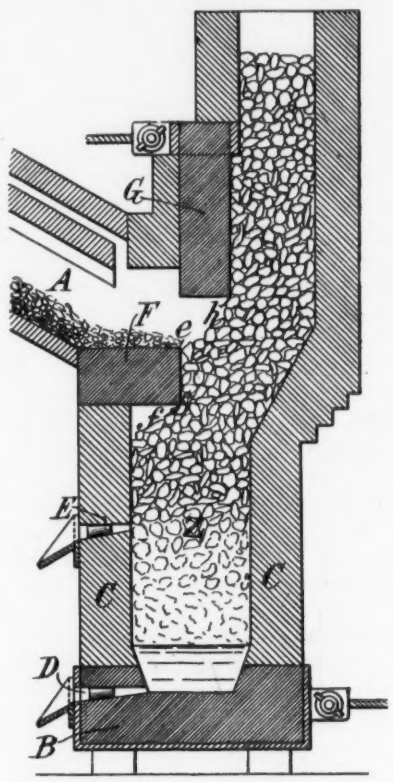
A patent, granted on July 7, to Mr. Emanuel Goldberg, of Moscow, Russia, is another example of that rather wide class of electroplating processes, in which an addition of an apparantly inactive compound to the plating bath is intended to give a bright and adhesive cathodic deposit. The inventor states that a pure white coating of zinc, which adheres well to the surface of the iron, is obtained, if to the zinc chloride used as electrolyte an organic compound is added which contains nitrogen. As suitable compounds he mentions amins, amids, cyanides, nitrites, etc., and states that the pyridin bases have given the best results. He dissolves 10 grams of zinc chloride and 10 cc. of pyridin in about 1 liter of water, and adds enough hydrochloric acid to dissolve the double salt which is formed. For electrolysis a cathodic current density not exceeding 0.2 amp. per sq. decimeter is used.

ELECTROLYTIC PRODUCTION OF CHLORATES AND PERCHLORATES.

A patent was granted on July 7, to Mr. Pierre Lederlin, of Chedde, France, for a process of electrolytic manufacture of chlorates and perchlorates. A cell is used without diaphragm, and as electrolyte a chloride, without addition of chromate or bichromate. An ampere-hour efficiency as high as 90 per cent. is claimed to be obtained, if the electrolyte is continuously maintained non-alkaline during electrolysis by suitable continuous additions of dilute hydrochloric acid.

STORAGE BATTERY INVENTION.

Two patents were granted to Mr. Wm. Gardiner, of Chicago, on July 7, for details of an alkaline storage battery with zinc as one electrode. When the cell is fully charged, the electrolyte is essentially an aqueous solution of caustic potash. During discharge zinc dissolves from the anode while the cathode—which is assumed to be an oxide of copper in one patent and an oxide of silver in finely granulated form in the other patent—is reduced. The cell is not an "oxygen-lift" cell, because the zinc goes into solution during discharge, the capacity of the cell depending upon the amount of zinc which can dissolve in the caustic potash solution, and therefore upon the quantity of electrolyte used.



HÉROULT ELECTRIC FURNACE.

As a solution of potassium hydrate is capable of dissolving but a relatively small quantity of zinc oxide, a relatively large quantity of electrolyte is required to get an appreciable capacity. The inventor believes he can get around this in the following way: In a strong solution of pure caustic potash he dissolves pure zinc oxide and uses this solution for charging the cell; zinc is therefore deposited from the electrolyte. He then removes this solution temporarily to another receptacle and dissolves again zinc oxide in it and uses it then again for charging the battery. This is repeated as many times as necessary to deposit as much zinc as corresponds to the capacity which the cell shall have. He then fills the battery with a fresh aqueous solution of pure caustic potash, containing no zinc oxide. The inventor believes that during discharge a far greater quantity of zinc is then dissolved in the caustic solution than would otherwise be the case; he believes this excess of zinc to be in an "unstable condition," so that it is "deposited almost immediately when the charging current is applied." Further explanations are not given. The cell is built up by placing a tray containing the active material of one electrode into a larger tray containing the active material of the other electrode, the bottom of the inner tray being of course perforated.

Proceedings of Niagara Meeting of the American Institute of Electrical Engineers. (*Continued.*)

Below appear abstracts of the remaining papers presented at the Niagara meeting of the American Institute of Electrical Engineers, together with abstracts of the following discussions, except the papers and discussions which dealt with high-tension transmission. Owing to the very unusual extent of the discussion on the several subjects grouped under this head, the length of the report is such that we are obliged to carry it over to the following issue.

SOME NOTES ON CERTAIN UNDERGROUND HOISTING PROBLEMS ON THE WITWATERSTRAND.

In a paper with the above title, Mr. A. W. K. Peirce sketched the present conditions in South Africa gold mines and the hoisting problems arising in connection with the more and more extended "deep level" operations. The principal power requirements of the mine equipment and the area over which the power is to be distributed—this being several square miles—practically determine the use of a polyphase system at a moderately high voltage. For hoisting, however, the author thinks direct-current motors to be more suitable than alternating. He recommends conversion to direct current separately for each hoist unit, and the utilization of the conversion machinery for obtaining suitable control of the hoisting operations by the voltage control or Ward Leonard system.

THE FACTORS WHICH AFFECT THE ENERGY LOSSES IN ARMATURE CORES

Messrs. J. Walter Esterline and C. E. Reid gave an account of an experimental investigation made at Purdue University. They describe an apparatus, devised for rapid yet accurate testing of sheet metal used in armature cores, the specimens for test being in the form of ordinary armature punchings. The authors also studied the effect of certain factors upon the energy losses which occur in the armature cores of generators and motors. The results are given in a large number of curves, showing the relation between the core loss and any one of the four variables—frequency, magnetic density, number of poles and depth of core—for various types of armatures. Some special results are evident from the curves. The curve for the cores having teeth shows considerably higher losses, than cores having a smooth periphery; this is due to the energy loss in the pole faces and the increased hysteresis loss resulting from the high magnetic density in the teeth of the core. Relatively shallow cores in which the magnetic density is more nearly uniform, have the lowest values of core loss for the same average magnetic density and frequency. There is practically little change in the core loss for different numbers of poles, for the same magnetic density and frequency, so far as the smooth cores are concerned.

In concluding his paper Prof. Esterline stated that for each smooth core a toothed core was also tested, the depth between the teeth corresponding exactly with the radial depth of the smooth core; as a consequence, the results from smooth and toothed cores are readily comparable.

Prof. Goldsborough pointed out that the curves of the paper when analyzed give much more definite information in the matter of losses and armature cores than we have ever before had. He explained at length the different conditions of flux with two, four, six and eight poles, and showed that there is a great variation in the density of flux between the inner and outer edges of the different laminæ, which may be as great as 14,000 lines at the top to 2,000 at the bottom. With a two-pole machine there is more variation than in the case of a four-pole machine, and a six-pole machine gives still less variation. In the case of eight poles the density in the air becomes very high, and the maximum watt loss instead of being between the poles is in the iron immediately beneath the poles. In reply to an inquiry, Prof. Goldsborough stated that the density of the flux was found by boring a series of holes through the core, and then by means of exploring coils and simply exciting the magnets, the distribution of the flux was accurately determined.

Prof. Franklin said that an argument as to the distribution of flux in iron could not be based on the assumption that the pole faces may be considered to be equal potential surfaces. Prof. Goldsborough pointed out some considerations which he considered showed conclusively that the average density in the pole face of a dynamo is greater than the average density along the surface of the armature between two pole tips. This can be calculated and also determined experimentally. Mr. Wilson said that what the designing engineer really wants is some method of rapidly and accurately calculating the core losses; that is to say, the loss due to hysteresis in the core itself, in the field and the losses due to eddies in the pole face and in the conductors, etc. Having obtained methods for calculating these details, then by actual tests he needs to obtain some correction factor which will make the result approximately correct for generators as a whole. The core loss will vary in different machines up to perhaps the eighth power of the density, though an average figure is the fourth power of the normal density. There are eccentric variations of the core loss with frequency, and it is thus impossible to make a general test agree with the results obtained from detail tests of the various parts. As to the loss in the teeth at high densities, he considered that as the teeth get saturated there is a large amount of leakage at the slot, and consequently increased eddies in the conductor. At the bend in the saturation curve the flux varies very rapidly, perhaps something like the tenth power, which probably accounts for the high density when comparisons are made on the basis of watts per pound. Mr. Mailloux pointed out that the curves in the paper can be approximately expressed by a simple equation, and showed how this might be done.

In reply to a question, Prof. Esterline said that no effort had yet been made to separate the hysteretic from the eddy current losses, but he hoped in the future to continue the work. Mr. Scott, in referring to the form of curves, said that the workman in the shop by filing an armature more or less or bolting it together a little carelessly, can shift the curves and thus invalidate the equations.

POWER STATION ECONOMICS.

Messrs. W. E. Goldsborough and P. E. Fansler, in a lengthy paper on this subject, give the results of a careful test of the economy of the main power station of the Union Traction Company of Indiana. It contains eight 400-hp water tube boilers, three engines each with a maximum capacity of 2,000 hp, direct-connected with a 1,000-kw, three-phase generator. The methods of the test are described in detail. The results giving the thermal efficiency of the plant are as follows: The efficiency of the furnaces and boiler is 79.6 per cent., i. e., 79.6 per cent. of the whole heat in the coal as fired is delivered by the boilers to the engines in the steam. The average thermal efficiency of conversion between the boilers and engine cylinders is 9.11 per cent., i. e., 9.11 per cent. of all the heat delivered in the form of steam by the boilers is converted into work in the cylinders of the main engines. This value of 9.11 per cent. credits against the engines the steam used in the auxiliaries. If the assumption is followed out that 15 per cent. of the steam delivered by the boilers is consumed by the auxiliaries, the thermal efficiency of the engines works out to be 10.7 per cent. The average total thermal efficiency of the plant is 7.25 per cent. from the coal pile up to the engine cylinders, and the total average thermal efficiency of the plant from the coal pile to the switchboard, i. e., the ratio of the energy delivered by the generators to the total heat in the coal, is 6.39 per cent.

Although it is frequently stated that the thermal efficiency of the steam engine at a maximum is about 25 per cent., it is impossible that any engine of this class working under these conditions will convert more than 12 per cent. of the heat of the coal into work. The thermal efficiency of 6.39 per cent. up to and including the switchboard shows high economy as compared with other stations of a similar character. The total thermal efficiency of the Harrison Street station of the Chicago Edison Company has been estimated to be 4.5 per cent., while that of the generating station of the Blue Island, Chicago Storage Battery Road was found to be 5.5 per cent. Indiana block coal is used, which is delivered at a cost of $1.35 a ton. On this basis the cost of developing one kw-hour is 0.28 cent. This cost may be taken as the final estimate of the efficiency of any station; figures of this cost in various stations vary between 0.246 and 1.016 cent.

After the reading of the above paper, Prof. Goldsborough said that the station described delivers to the line 6.23 per cent. of the total energy of the coal, but that only 3.65 per cent. of the total energy gets to the cars. The efficiency of transmissions between the station and the cars is, therefore, only 50 per cent. Mr. M. H. Gerry said that if everything were included between the electrical output of the station and the electrical input at the cars, the total efficiency of the plant at the car axle would certainly be reduced 25 to 30 per cent. more, bringing the total ideal efficiency of the installation down to or around 2 per cent. Prof. Goldsborough considered this to be a fair assumption, but he pointed out that power

is developed so cheaply that this becomes a small factor, one passenger per car pretty nearly paying the cost of the power used by a car from Indianapolis to Muncie, the fare, moreover, being only one cent a mile. A good deal of money is being made on this basis, the property being a profitable one.

Mr. Gerry said that the plant was not an example of a high efficiency or even of an average efficiency plant. Prof. Goldsborough replied that the plant has a very high financial efficiency, which he considered to be a better than a high power efficiency. To reduce the transmission losses would increase the capital charge, which increase might more than balance the cost of coal. Mr. Gerry said that he did not see why a high-efficiency station should be installed to make power cheap and then a low efficiency distributing system put up which will waste that power afterwards. If one can produce power cheaply and wants to keep down the first cost of a station, he should not put in a modern high-class system all the way through. In reply, Prof. Goldsborough said that if a low-class generating station, low-class transformers, low-class rotaries and batteries were put in, the cars would not get the required per cent. of power of the total energy generated. The present station has the highest class of generating machinery and should it become necessary to increase its earning capacity, all that would have to be done would be to increase the copper in the lines. There is no excuse for putting in bad machinery, but when it comes to the size of copper conductors, that is another thing. At present the voltage is 18,000, but in extending its system to Logansport the company will use 32,000 volts. Perhaps some day, instead of operating with a direct current of 5,000 volts, it will operate with an alternating current of 10,000 volts. Mr. Gerry, in reply, said that the highest efficiency machinery designed did not always give the best operating result, and to him it is a question whether in this case refinements were not made in the station and sacrifices in the transmission system.

Mr. H. G. Stott said that the ultimate object in any power plant is to deliver a kilowatt-hour to the receiving apparatus at a minimum cost, and that there is no other object in a power plant. If the coal is expensive, an extremely efficient plant must be put in; but if coal is very cheap one can afford to sacrifice a good deal and reduce the cost charges of the plant. In the end, however, one must consider the whole problem; that is, the cost of the kilowatt-hour delivered at the receiving apparatus. He considered that in the paper just read the fuel cost is only given, whereas the total cost of the delivery of power is the real test. In the New York Manhattan plant the cost of coal is 70 per cent. of the total operating expenses up to the track of the elevated road, and consequently an extremely efficient distributing system and power plant is required. He thought that any comparison of efficiencies was unfair when calculated merely on the ratio of indicated horse-power to kilowatt-hour output. Mr. Mailloux agreed with Mr. Stott and said that the real question is what is the kilowatt-hour is going to cost delivered. He said that recently he was approached by a representative of a concern making gas engines, in connection with a plant of 15,000 or 20,000 kw, which he is designing for railway work, who made the statement that he could enable him to save $100,000 a year in fuel. Mr. Mailloux found that he could, with the engines proposed, make a very material saving in coal, but that the additional cost of buildings would be greatly increased; for instead of being able to use three large turbine units of 4,000, 5,000 or 6,000 kw each, he would have to use ten gas engine units. The initial investment would be one-half million dollars greater, and considering the fixed charges and the cost of producing power, the proposition entailed a loss of $100,000 a year instead of that much gained. This example illustrates the necessity of taking all circumstances into consideration in making comparison of methods of producing and delivering current.

Mr. Gano S. Dunn referred to the vague manner in which the term "cost" is used, and thought that it would be well never to use that word without defining what it was intended to include. It would be desirable when costs are considered before the Institute or for statistical purposes, that they should include fixed charges, taxes, depreciation, sinking fund charges, interest on bonds, and every other factor, as well as the charge on any extra cost in the way of buildings or otherwise that a proposition entails. Our statistics on the subject of cost of power are of very little use, because of the lack of definitiveness in specifying what we mean and what we include when we say "cost." Mr. Paul Lincoln said that the question which Mr. Gerry raised seemed to be simply a question of Kelvin's law. Power can be developed for a certain sum at a station, and it is merely a question of how much of that shall be lost in the line. If power is cheap, more power can be lost in the line than if power is dear. It is for an engineer to determine whether he shall put money or energy into his line. Mr. Mailloux said that he could mention many cases where the cost of fuel has a very great bearing upon the selection of machinery and the design of the installation. Mr. John F. Kelly said that the heedless application of Kelvin's law would be apt to lead to considerable bad engineering. The law has an important proviso, namely, "provided that other things be equal." If the energy generated is used for lighting, it must be delivered at a practical constant voltage, which limits the application of the law in that particular case, and the same may be true in other cases. Referring to the system described by Prof. Goldsborough, he was inclined to think that the discrepancy between the two parts was due to the fact that the cheaper station was laid out by an engineer, and the other part put up by a lineman. He agreed with Mr. Gerry that very often the lower efficiency machinery is much more stable, may run better and last longer than the higher grade machinery. Mr. Gerry agreed with Mr. Dunn that power data as a rule are absolutely worthless because the various factors that enter in cost are either not included or are based on assumptions so much at variance that one plant cannot be compared with another. Another point which affects the cost of power is the form of the load curve. He suggested that for determining cost, certain rules be formulated, certain interest charges determined upon, certain relations established between average and maximum power; in other words, all station factors should be taken into consideration in a definite way, and we might then arrive at a form of stating the cost of power so as to make comparisons possible within a few per cent. of error. President Scott said that Prof. Goldsborough had rested upon the cost of fuel per kilowatt-hour output, which is an entirely accidental thing; for the cost of coal varies greatly, and the discovery of a coal mine in the vicinity might reduce its cost to half. It has been suggested that the total cost should include cost of handling and attendance, but that would depend upon the current rate of wages in any part of the country. He thought that in consideration of such problems, two things should be considered separately—first, the purely engineering problem, and then the application of the engineering to the commercial problem. In concluding the discussion, Prof. Goldsborough said that the reason no more figures were given in the paper was because he could not obtain the consent of the owners of the plant to print all the data which he had obtained. Replying to Mr. Kelly, he said that if one were to inspect the line in question, which carries 16,000 volts on the top of the pole, 500 volts half way down and a telephone line a little bit lower, all three of the lines working perfectly with no disturbance in the telephone system—he would not conclude that the line gave evidence of bad engineering.

CATHODE RAY ALTERNATING CURVE WAVE INDICATOR.

One of the most interesting papers read before the meeting was that by Prof. Harris J. Ryan, in which he describes an application of the cathode ray to a determination of alternating current wave forms. As well known, a cathode stream is subject to large deflections by comparatively weak magnetic fields, and taking advantage of this fact, Prof. Ryan has devised a very efficient wave indicator. The cathode ray tube is operated by a motor-driven electrostatic machine, and all of the rays are stopped at a diaphragm except a pencil, which passes through a small aperture at its center. The current whose wave form is to be indicated, passes through an electromagnet placed near to and at right angles to this pencil; a second electromagnet is arranged with its axis at right angles to the first mentioned one. Through one of the coils the current whose wave form is to be indicated is passed, and through the second a current of known wave form is passed. As a result of this disposition, the pencil of rays will trace on a fluorescent screen a curve which may be photographed; and as inertia does not enter, the trace is accurate in its indications. As this curve is resultant of two motions, one of which is known, the values of the unknown curve may be simply separated and plotted. One of the advantages of this method is that the phase position of the control or sine wave can be adjusted so as to cause the more intricate portions of the unknown wave form to occur at the time when the rate of change of the sine wave form is most rapid; consequently, the resulting cards can be so adjusted as to bring out the desired details to the fullest and clearest extent.

President Scott said that when he first came into electrical work, some fifteen years ago, a striking paper opening up a new field and illuminating it had just been presented by Prof. Ryan, on the wave forms of the e.m.f. on transformers of different sizes and under different conditions. Mr. Gano S. Dunn expressed his appreciation of the work of Prof. Ryan, though it might be asked, what has a direct-current man got to do with wave forms? In point of fact, the direct-current man has to do with frequencies between say 60 cycles per second and many hundreds of thousands per second. These frequencies occur in the complicated phenomena of commutation, and he explained in detail some of these phenomena and showed what an important influence they have with respect to sparking. In a specific case to which he referred, phenomena were present having a frequency all the way from 800 to 8,000 per second. The complications that might arise from this condition cannot be predicted, but with a wave tracer such as that of Prof. Ryan, he thought that the causes could be determined and thereby give a solution of the general problem, which would be a valuable contribution to the design of direct-current machinery.

In reply to a question, Prof. Ryan said it is not possible to photograph a single tracing, the light given off by the fluorescent screen not being strong enough. For periodic work, however, it is easy to photograph with an exposure of from two to five seconds. Mr. Hammer suggested that the Lenard tube with an aluminum window could be used, as by these means a record could be made directly on photographic paper. Prof. Ryan said that the suggestion was a very interesting one, but Dr. Sharp added that the cathode rays, after passing through the window of a Lenard tube are quickly absorbed by the atmosphere. Mr. Hammer, in reply, maintained the practicability of using the Lenard tube. Prof. Goldsborough moved that the Institute accord a vote of thanks to Prof. Ryan, which motion was seconded by Dr. Kennelly and carried.

THE LEGALIZED STANDARD OF E.M.F.

Prof. Carhart presented a paper in which he discussed the value of the e.m.f. of the Clark and cadmium cells. He recalled that the Chamber of Delegates at the Chicago International Electrical Congress, had fixed upon 1.434 as the e.m.f. of the Clark cell at 15° C. Germany did not legalize this value, and the Reichsanstalt has used the value, 1.4328. Prof. Carhart says it is quite certain that the actual e.m.f. is nearer 1.433 than 1.434. In 1899 Profs. Carhart and Guthe made an absolute determination of the e.m.f., which gave the value 1.4333 at 15° C. Later Dr. Barnes, of McGill University, made a series of determinations of the mechanical equivalent of heat in terms of the international electrical units, which agree with previous determinations of Reynolds and Moorby, made by a purely mechanical method, if the e.m.f. of the Clark cell is 1.43325 at 15° C.; and they agree with Rowland's determination if the e.m.f. is 1.43355.

During the past year Prof. Carhart has taken up the measurement of the e.m.f. of the Weston cadmium cell, and the electrochemical equivalent of silver. The Weston cell was chosen because of its low temperature coefficient and the close agreement between the different cells of a series. The ratio between the e.m.f. of the Clark cell at 15° C. and that of the cadmium cell at 20° C. has been carefully determined in a series of experiments at the Reichanstaldt, in one of which Prof. Carhart assisted, and found to be 1.40670. An absolute determination of the cadmium cell is, therefore, one of the Clark cell, as the ratio is known to a much greater degree of accuracy than the e.m.f. of either can be measured.

The investigation is not yet completed; a series of cadmium cells has been made and it has been found that the several cells agree well among themselves, the variations being smaller than the limits of accuracy that have been set. Prof. Carhart considers that the low temperature coefficient of the cadmium cell is an advantage of the greatest importance, and the marked uniformity shown by different series of cells is so marked as to constitute another count in its favor as a standard. In conclusion, Prof. Carhart made the following recommendations:

First. That the Institute appoint a committee of three to prepare a complete specification for the normal cadmium or Weston cell.

Second. That the cadmium cell, as thus specified, shall be adopted as the standard of e.m.f. by the Institute and that steps be taken to secure its legal adoption by Congress, provided it be dedicated to the public by the inventor, one of the distinguished past presidents of this Institute.

Dr. Sharp seconded the recommendations of Prof. Carhart. He considered that the matter of a universal standard e.m.f. is a very important one. The German volt, for example, differs from that in use in this country by .1 of one per cent., which difference is a matter of great importance in any work of precision. The Clark cell is troublesome to use, and he believed it advisable to replace it with the cadmium cell, which is in every way better adapted for use as a primary standard of e.m.f., being more easily prepared and intrinsically more easy to use. He referred to the fact that many laboratories do not have a potentiometer, and to his mind this instrument is of far greater engineering importance than the Wheatstone bridge. In engineering we wish to measure two things, e.m.f. and current, and for measuring both according to best methods a potentiometer is needed in connection with a standard cell. The standard cell is not as delicate as is generally considered, as it will submit to a great deal of bad usage and recover from it. If short-circuited its usefulness will be destroyed for several days, but it will then come back to normal and can be used again.

Mr. Carl Hering thoroughly agreed with the recommendations of Prof. Carhart, and suggested that specific names should also be determined upon for the two different cadmium cells, so as to avoid the confusion that now exists. At present it seems that the saturated cell is called the cadmium cell and the non-saturated cell the Weston cell. Mr. Hering thought that the first one being the real standard should bear the name of Weston. Prof. Goldsborough agreed as to the extreme value of a recognized standard of e.m.f., and he considered that such action as had been suggested would be hailed with pleasure by the officers of the National Standardization Bureau, at Washington. He suggested that the committee recommended by Prof. Carhart be appointed by the Board of Directors of the Institute with instructions to report at the St. Louis general meeting in September, 1904; and that 25 copies of Prof. Carhart's paper, together with the discussion of the same, be sent to the secretaries of each of the national electrical engineering societies abroad and also to the secretaries of the several standardizing laboratories of Europe, as well as that in Washington. Mr. Hering though that the report should be made as soon as possible in order to give time for expression of opinion both in this country and abroad before the congress meets; the object of the congress is to settle discussion, which should precede its meeting. It was finally decided that the committee should prepare its report at the earliest moment, in order that it might be sent out for discussion previous to the meeting of the congress. Prof. Carhart said that the National Bureau of Standards at Washington is entirely in sympathy with the work that he is doing, and that the bureau proposes to duplicate the electro-dynamometer which he has devised for use in the investigations.

THE MAGNETIC UNITS.

Dr. A. E. Kennelly discussed in a paper the subject of magnetic units and the nomenclature in general of units. The paper opens with a historical summary, giving an account of the action that has been taken with respect to electrical units from the first B. A. report in 1873 to date. While agreeing that a rational system which would eliminate the numerical constant 4π would be preferable to the present C. G. S. system, it would now be very troublesome to change to the latter. The one compensation for the trouble and expense would be a certain amount of scientific simplification in the theory of electromagnetism and a certain benefit to scientific computors. The electrical industries would not receive any practical benefit, and any benefit at all would be the small amount derivable from the simplification in theory already mentioned. As to the several ingenious expedients which have been proposed for effecting partially the rationalism of the C. G. S. electromagnetic units, it is very doubtful whether such half-hearted expedients can succeed, and it thus seems better to let the extending system alone. After years of experience, it is now easy to see that the correct original course would have been to christen the C. G. S. magnetic units without regard to practical magnitudes employed, and at the same time adopting a suitable series of prefixes for decimal multiples and sub-multiples. If, for example, the C. G. S. unit of current strength (10 amp.) had been originally christened the ampere, our present ampere would have been known as a deciampere, and we should have become as familiar with such a term as we are now with the ampere, as the use of the microfarad indicates.

Dr. Kennelly considers it very desirable that the international congress should complete the units of the magnetic circuit by bestowing names upon the C. G. S. units of magnetomotive force and of reluctance, for which the Institute has recommended the names

gilbert and oersted, which are already in some use in this country. He also thought that the C. G. S. electromagnetic units should have names; this is desirable for scientific purposes, for educational purposes, and in the interest of progress. He suggested the expedient of employing the prefix ab or abs to a practical unit, in order to express the corresponding C. G. S. unit. Thus the C. G. S. unit of e.m.f. would become the abvolt, the unit of resistance the absohm, etc. The electrostatic units might be attended by the prefix abstat; thus the C. G. S. electric unit of e.m.f. would be the abstatvolt; the unit of current abstatampere, etc. He considered it desirable that such a system of christening the C. G. S. electromagnetic and electrostatic units should be adopted by an international electrical congress; and that it is also desirable that such a congress should sanction the use of the Hefner-Alteneck standard amylacetate lamp as a secondary standard of light intensity.

It is also desirable that steps be taken by such a congress to establish a uniform international basis for the standardization of electrodynamic machinery. It is perhaps impossible to carry the principle of international standardization very far into detail, since many details obtained depend in each country upon local and industrial conditions; but on the other hand, there are many underlying physical conditions that might receive notice among electrical engineers. For example, the dynamo ought to have the same rating based on temperature elevation all over the world.

In the discussion Prof. Goldsborough said that for a number of years past he had found it very convenient to make up new names for the magnetic units which thus far have not been christened, and to use them in discussing related matters with his students. He has found that as soon as a student is given a definite name for a specific thing he more readily gets a concrete idea of the thing. He made a motion that copies of Dr. Kennelly's paper when printed be sent with copies of Prof. Carhart's paper, to the secretaries of the various institutions mentioned, for the purpose of calling attention to the matters therein considered. Prof. C. D. Jackson seconded the motion, which was carried.

THE ELECTRICAL EQUIPMENT OF A GOLD DREDGE.

In a paper on this subject, Mr. Ralph L. Montague makes first some general remarks on placer mining and then describes at some length the first successful application of a gold dredge to placer mining in America, at Bannock, Mont., in 1895. He then discusses in detail the nature of the loads on the various direct-current motors in a gold dredge.

Mr. Scott said that the paper is of interest, not only in showing the means of application of power to an interesting and important work, but also as indicating the value and flexibility of electrical power in an industry of the kind, where power is wanted in fairly small units, and where it would be very difficult to get it in other ways. He considered that the application of electric power in mining is effecting great results in that industry. Mr. Skinner said it is interesting to see these dredges at work, going over ground that had been completely worked over by hand and getting good financial returns. Tremendously hard service is required of the motor driving the buckets; he has seen these stalled many times and burned out, it being necessary at times to reverse the motor and subject it to strains that twisted shafts supposed to stand any duties that the motor could be made to perform.

ENGINEERING EDUCATION.

Prof. W. S. Franklin, in a paper entitled "The Teaching of Physics to Engineering Students," pointed out that the ultimate object of the teaching of physics to technical students is to lead the young man by a shortened route to that familiarity with physical things which is possessed by such a man as John Fritz. The shortening of the route which leads to this result depends upon the fact that the teacher of physics has to do largely with an epitome of real knowledge, and consequently the primary object of physics teaching is to develop in the young man's mind a logical structure consisting of the aggregate of physical conceptions and theories. The teacher should never apostrophize the wonders of Nature to his class; he should never allow the slightest speculative tendency to enter into any of his teaching.

The author recommends the use of sharply, clearly and concisely written text-books, to give explanatory lectures of such character as to appeal properly to the student's imagination—theoretical lectures illustrated by the simplest kind of experiments—to require of the student a large amount of numerical calculation and to give a laboratory course based upon highly generalized printed directions supplemented by a vanishing series of verbal suggestions from an instructor. There is nothing in the teaching of physics so important as to develop in the student the ability to express physical conditions in mathematical form, geometrical or algebraic as the case may be, to reproduce or re-present the conditions of a problem adequately as a geometrical construction of as an algebraic formula. Nothing is so important as this for technical students.

In the discussion of Prof. W. S. Franklin's paper, Prof. Goldsborough was the first speaker. The students should have a thorough and complete drill in theoretical electricity and they should be taught to apply that theoretical training in practical work; they should not be sent out to college with a theoretical training and a practical training which to the student have no relation to each other whatever. It takes time for a student to become thoroughly familiar with even such elementary terms as volts and amperes, or with the more complex conceptions of alternating current theory. Students should not be allowed to jump to a final formula which shows a result; they must be made to go right back to the beginning and start and go right down through; until they understand what has gone before, until they comprehend all the factors entering, they have no business discussing the final formula.

Prof. Langsdorf said there are two ways of teaching laboratory work. The one is to give the student at the beginning the equation which represents the relation between the quantities which he is measuring, and allow him to have the data from the laboratory and verify the equations by substitution. The other method is to give him the apparatus, tell him to take the data, plot his curve and determine the equation from the curve. By this second method the student acquires an understanding of the meaning of formulas which he cannot acquire in any other way. And this second method is the only one which should be used, which should be thoroughly impressed on the mind of the student.

President Scott referred in this connection to an incident in his own education. When he left the college, the ampere and volt and coulomb and watt, all had about equal importance and significance to his mind. But when he got out among workmen and engineers he found there was one of the units for which they had the greatest respect and that was the watt and the kilowatt, *i. e.*, the unit of power, the unit of activity. Prof. Colwell said the student should be impressed with the importance of the original notes which he takes in the laboratory; they are more important than the report sheets.

Mr. E. H. Mullin, in a paper entitled, "Training an Artist in the Forces of Nature," presented a strong plea for education in its broader sense, as contrasted with mere storing of facts in the mind of the student. With knowledge alone, we live in a flatland, and realize our neighbors only when we touch them, whereas by the added culture we can rise above our surroundings, and by viewing the relations of our neighbors to each other, form a just estimate of our relation to them. The pure specialist, without sympathy and without comprehension, is simply a machine tool in the hands of a higher order of intelligence. It is not the knowledge of facts which makes a man educated, but the possession of method. To teach a man to learn how to learn is the true function of education, and to stuff his mind with facts beyond this point is merely to encumber him in pursuing his means of livelihood. Education is not so much intended for the elucidation of old problems as for the tackling of those that are new; and as a knowledge of facts without the power of reasoning is worthless for new adventures, and as every problem which meets us in life is a new venture, therefore method by itself is everything, and facts by themselves are nothing.

Mr. Mullin divides education into two branches—education as an art itself, and education as a science. In every stage of education as an art, there are two things to consider—the accumulation of a sufficient number of names and their connotations to give an ample nomenclature or set of tools, and also enough familiarity with this nomenclature or set of tools, to enable one instinctively to select the right tool and use it efficiently. Having obtained the tools through education as an art, the problem in education as a science is not to use them as we have been doing, but to apply them to new problems. Here not only is memory needed but imagination, and the highest function of education as a science is to make a man of average ability see resemblances and differences in things where he would otherwise be blind.

As to the essentials of an engineer's education, a sound knowledge of one's native tongue is the best substructure. The great engineers

who have been deprived of this aid, have borne eloquent testimony by their efforts at self-improvement in later life to what they considered would have been its usefulness at an earlier period of their careers. An elementary knowledge of Latin is almost indispensable to the clarification and consolidation of the knowledge of nearly every European tongue. Next to these is a good working knowledge of French because besides its obvious advantage as a language to be spoken, it imparts lucidity and precision to writing—a thing, by the way, which mathematics often fails to do. Early practice in mechanical drawing should also be given to every boy who feels within himself the stirrings to become an engineer, because facility with the pencil is easily acquired early in life, but is often one of the greatest stumbling blocks when taken up too late.

As the profession of an engineer always involves constant dealing with quantities and values, he ought to know mathematics as he knows the currency of his native country. In other words, he ought to be able to make change with ease, quickness and accuracy—not as if one were in a foreign country in a constant state of painful reckoning. A thorough knowledge of ordinary mathematics is prescribed, not any vain ascents with crippled wings into the empyrean.

The first part of the superstructure should consist in learning the principles of the applied sciences. These should be studied in books, assisted by oral teaching, and enforced and re-enforced by the practice of dozens or hundreds of examples. If one wants to know how each principle should be learned, he should watch a great singing teacher train a pupil. A false note in a scale demands a hundred perfect repetitions. A false note in an *aria* means back to the scale for a hundred more repetitions before attacking the *aria* a second time. Why should the future artist in Nature be less carefully prepared for his work Is that work likely to be less important? Or is it merely because his future audience is less likely to detect a false note?

With this, the education of our engineer ends, or rather begins. He may be fifteen, sixteen or any age. He may have studied in school, or in college, or at home. He is, however, a trained engineering soul, according to the measure of his talents. He is able to learn the art of engineering, or any other art, for which he has an aptitude, in months, where another man of equal ability might take years and not know it half so thoroughly. All he needs to ensure his success in life is to find a master who can utilize his powers.

Mr. T. J. Johnston, in a paper entitled "Engineering English," referred to the fact of everyday experience that no two engineers describing the same phenomenon will give anything like the same description, and this is due not to their want of knowledge of the phenomenon, but to the inaccuracy of their language. The author urges that English composition should be kept up in engineering schools and that engineers should be drilled in the use of English until they can express with entire accuracy the meaning which they so often commit to formulas. He refers to the inaccurate use of some terms common in the profession, such as static transformer instead of stationary transformer, capacity of a system instead of maximum output, field of a generator instead of field magnet, etc.

Mr. L. A. Osborne, in a paper entitled "Proper Qualifications of Electrical Engineering School Graduates, from the Manufacturer's Standpoint," pointed out that our technical schools to-day are admirably fitted to turn out men who are well grounded in the fundamentals of engineering; as a rule, they are good mathematicians, electricians, chemists and physicists, and have all the technical knowledge necessary for pursuing the profession, but they are as a class woefully lacking in that they have no comprehension whatever of many of the subjects which are inseparably connected with the practice of the profession. The majority of the technical school graduates leave college with but very hazy notions either of the function of tools, the principles of their design or the machine organization of a shop. A more thorough knowledge of works organization as applied to the personnel is highly important. There is no more vital subject facing the industrial world to-day than the relation between employer and laborer; a course is recommended which would bring to the student's attention the history of the relations between capital and labor and the economic laws relating thereto. The engineering course should also include a short course of law in its relation to contracts. The author believes that much of the manual training which now occupies such a large proportion of the "actual hours work" in the courses of most technical schools could be replaced with profit by lectures on the subjects mentioned.

"The Proper Qualifications of Electrical Engineering School Graduates from the Telephone Engineer's Standpoint," was the title of a paper presented by Mr. Bancroft Gherardi, Jr., chief engineer of the New York & New Jersey Telephone Company. The qualifications of electrical engineering school graduates are the product of two factors—the natural ability of the man himself and the training which he receives at the engineering school. Telephone engineering is one of those specialties into which electrical engineering in general is rapidly splitting itself, and in consequence of this fact, it has been assumed by some that the school training for the telephone engineer should be different from that given to electrical engineers in other branches. The author does not altogether agree with this proposition. After all, the telephone engineer's work is based upon the same essential principles which underlie the work of all of those engaged in electrical engineering. Instead of attempting to teach ultimate practical problems, the important matter is that engineering students should have discipline in the methods of solving engineering questions. Such discipline can be best given by a general training which will enable him to solve any question that may arise when he becomes acquainted with the conditions of that special problem.

The function of technical education is to train the student so as to convince him of the necessity of getting his facts and to teach him the best methods of getting the facts—to train him as to the methods of interpreting engineering data and reasoning thereon. It is the work of a lifetime to acquire the voluminous data representing the state of the art in the case of any branch of engineering. It would be impossible to attempt to teach such data. The author emphasizes that extraordinary efforts should be made to teach every engineering student to write a report or letter in clear convincing English, setting forth the facts and arguments and conclusions on any question which he may have to consider; but clear thinking must precede clear writing.

A student should receive a good training in elementary physics and analytical mechanics and the application of analytical mechanics to engineering problems; in mathematics the usual training leading up to and including the calculus is sufficient for general engineering work in telephony. In electricity, the student's work should, of course, be carried much farther than in the other branches of physics, and he should have a thorough knowledge of both direct and alternating currents. In experimental laboratory work he should have a fair amount of experience. A certain amount of practical experience in shop work should be given to the student so as to familiarize him in a general way with various classes of shop practice; but it is easy to run to excess in this respect. A student should acquire a certain amount of knowledge in regard to legal questions. Examples from practice should be used to illustrate the fundamental laws and to show the student how apparently remote scientific principles are really of the utmost importance in the solution of very many practical problems.

In his experience with technical school graduates, he has found a number of defects. Many graduates do not seem to appreciate that engineering is the determination of the most economical way of accomplishing a desired result; in too many cases they are satisfied when they have determined one way of accomplishing a result. Too often beginners in engineering think that an arithmetical error in their work or the use of a wrong number is no serious error; great emphasis should be laid upon accuracy. Errors due to lack of accuracy should never be condoned in the student's college work. Often graduates have too little appreciation of the relation between their theoretical knowledge and practice; they have no physical conception of what corresponds in nature to their theoretical information.

In a paper entitled "The Problems that Are Facing the Electrical Engineer of To-Day and the Qualities of Mind and Character which Are Needed to Meet Them," Mr. J. G. White summed up the qualities of mind and character needed by the electrical engineer of to-day. He should be accurate in his calculations, thorough in his investigations, logical in his deductions, lucid and concise in his statements. He should have untiring energy, an alert mind, abundant initiative and reasonable self-confidence. He should be absolutely honest in all his dealings, truthful in all statements, loyal to his clients, faithful to his emyloyer's interests, considerate of his own subordinates, diplomatic in his negotiations and tatcful in all his relations. The author, in discussing the question, What education should the engineer of to-day have? said that this is the age of great industrial combinations and of

specialties. Not satisfied with this, the specialists now specialize. A few years ago many would have supposed that the problems of the "telephone engineer" were those of a high-classed artisan; now we have elaborate exchanges, and know that he may receive a very high salary and is expected to know something of architecture, the strength of materials and other factors entering into modern steel building construction, and many other subjects which should be a part of a broad engineering education, but which are not ordinarily supposed to come with the province of a telephone engineer.

It is at least equally important that other engineers who have specialized and must know well some part of the field of engineering, should likewise have a general knowledge of the sciences and of the broad underlying principles of engineering. Much of the special knowledge of an engineer must be acquired after he has commenced the practice of his profession. If unusually energetic and capable, all or any part of his education may be gained after he enters professional life, but it is preferable that his broader education be well started during his school years. More important, however, than a knowledge of any study, or group of studies, is the ability to master thoroughly any subject of which a knowledge is desired. In education quality is a much more important essential than quantity.

The author discusses in detail the various points which speak against an extended college education and those which are in its favor. More important than the knowledge actually acquired, is the learning how to know a subject, and where or in what direction to look for information specifically wanted. With equal industry and attention to his work, the young engineer of ability with a broad education will ultimately take a higher rank in his profession and be more successful in busines. On the other hand, the engineer of ordinary or less than ordinary ability will in practical life accomplish most by not attempting to spread his education over too wide a field, but by learning some special department thoroughly.

A young man should take for his motto thoroughness. His study should include first subjects of prime importance and only after they have been mastered, subjects of less importance. Preferable is a broad general education, supplemented by thorough technical training. This may and frequently will lead to a general college course, to be followed by a technical course of two or more years.

The author distinguishes four classes of studies, according to their importance. In the first class he puts the most important ones: English, arithmetic (mental and written), algebra, geometry and trigonometry, chemistry, physics (especially metchanics), general knowledge of principles of electrical engineering, practical ethics.

The second class includes calculus and vectors, surveying, Latin, French (speaking and reading), electrochemistry, advanced engineering studies, business law, general principles of modern accounting, civics.

These two classes cover the most important subjects, while the third and fourth class include subjects which will help in rounding out the education, although they are of less imbportance. The third class includes Spanish, geology, physiology and temporary care of injured, logic, quaternions; the fourth class includes mineralogy, botany, zoology, history, political economy, mental and moral philosophy, art, music, etc.

The author emphasizes the great importance of continuous training in English, and recommends the writing of laboratory reports, examination papers and other similar documents. More attention should be paid in the preparatory schools to algebra and arithmetic, especially mental arithmetic. He recommends a course in surveying; a summer spent on railroad location and construction will fe found to have been well spent. The most useful modern language for the engineer is French, and only if he speaks this language fluently should he undertake to learn another language; Spanish would then be the best language to acquire. He recommends a moderate amount of training in modern business methods and practices, in accounting, and in the fundamental principles of business corporation law. An engineer should at least be able to draw a contract which will be legal and explicit.

A modern engineer is dependent for his success largely on the financier. If the engineer does not know that bonds should pay interest and that stocks, if possible, should pay dividends, and has no conception of the difference between a stock certificate and a promissory note, the financier is likely to form an undeservedly low opinion of the engineer's technical konwledge.

If a young engineer will have before him constantly the ultimate and best interests of his employer, will endeavor always to be tactful and never to unnecessarily irritate, will—without flattery—say only what is pleasant, unless right demands a plain statement of an unpleasant truth, then his advance will be more rapid than if these things should be forgotten. The importance of these things should be pointed out and frequently emphasized by educators.

In the discussion of the above papers, President Scott remarked that during the last fifteen years the growth of engineering schools and of engineering courses has been phenomenal but students have come faster than the equipment and the facilities, and notwithstanding the size of the graduating classes, they are still inadequate to meet the growing demands for educated engineers. The conditions now existing in active life and practical work for the engineer; the demands of engineering work and the place it has taken, mark a new order of things in modern society. In the several papers under discussion the authors emphasize the want of engineers who are broad men; they call for quality of work in college, and not quantity; they call for discipline, for mental training, to give the ability to take up and handle new problems. President Woodward, of the Society for the Promotion of Engineering Education emphasized the great interest which papers written by practical men must have to professors and teachers.

Prof. Goldsborough said that until the engineers get to the point where they are willing to accept from professors criticism on the way in which they do their work, they should not be too quick to criticize the way in which professors do their work. He emphasized that the most important element in a young man's education is military discipline, military drill; this is the keynote of all education, to learn how to obey orders. He criticized Mr. Gherardi's requirement that telephone engineers should learn everything that electrical engineers learn, and a lot more; where shall the time be taken from for all of this? The boys who are going to be bone and sinew of the engineering profession are generally young men without financial means. Sometimes their fathers cannot speak English and they come right out of the backwoods; they have no advantages, but they persevere, and they materialize, and they are put in charge of the most important works of big companies, spelling or no spelling, English or no English. The thing for our boys when they graduate is to be given a chance to work into the field of engineering, to be encouraged by their employers to prepare work, to prepare papers, to broaden themselves. Prof. Goldsborough in conclusion expressed the opinion that the best training for the business man in our days is engineering training.

Prof. Jacobus stated that in several of the institutions of this country courses are suggested by which the student may obtain the college course and the engineering course in six years; by properly electing the work in physics, chemistry, geology and other subjects in such a way that he gets his degree of B. A. at the end of four years, he will be in a position to start right in at the beginning of the junior year and complete in two years the engineering course, and have all that is required in both.

Dr. Ganz, of the Stevens Institute, recommended inspection trips to the works of manufacturing companies; they should, however, be preceded by lectures on the things which the students will see. Prof. Colwell said it would be more desirable if practical men would state exactly what to leave out of the college course, not what to put in. Prof. Diemen recommended that students in electrical engineering should join the courses given to mechanical engineering students, in factory organization and shop economies.

Prof. Allen said it is impossible, for our engineering schools to turn out a finished engineer; the college is under obligation to provide the student with the proper theory, but proper theory cannot be given without practical applications. The engineering college can give only so much experience as is necessary to give point to theory and as is required to put the student graduate in the way of gathering the larger experience which shall make him a complete and valuable engineer.

Prof. C. A. Waldo asked Mr. White why he would retain Latin in the education of the engineer. Mr. White, in his reply, said he considered the study of Latin as only of secondary or tertiary importance, and it might be omitted. Prof. Goldsborough explained more in detail what he meant in some of the remarks made by him earlier in the discussion. Practical men in their papers on education of engineers, always speak of the courses on colleges, but it would be better if they would clearly outline and tell the course that the men are put through after they graduate, what is demanded of them and the order in which it is demanded. Then teachers will know what they must develop their boys for.

Prof. H. S. Carhart pointed out that there should be no differentiation in engineering training in the schools; the differentiation should come in practice, after the man is through with the technical schools. In the university principles should be taught, with enough of laboratory or shop work to give point to those principles, to connect them with real practical affairs, and not to let the laboratory or the shop encroach upon the valuable time of the student further than this. Graduates can get more experience in practical affairs in six weeks in a large manufacturing establishment than they can get in college in four years. Instead of trying to make a complete mechanical, civil, electrical, marine, telegraph, telephone or any other sort of engineer in a training school, the course should be arranged so as to make an engineer. He may apply himself the adjective after he gets into his practical experience. The effort should be to lay a broad foundation in those subjects which the engineer must have to build upon.

President Scott called attention to a point brought out in Mr. Osborne's paper, namely, that probably only one-tenth of the engineering graduates go into engineering pure and simple, and the other nine-tenths into allied industries and executive positions. This indicates that there is a demand for engineering in the broader sense, that engineering training is useful in other lines of activity than pure engineering.

Mr. Rushmore referred to the "message to Garcia"—to get an order and do it, that is all. The principal thing in an engineer is not so much the information he has, but what he is in himself, his ability to go ahead, and above all things, accuracy. Instead of teaching a man all the small things that he might want outside, the college should give him a strong basis in fundamental principles; he will get the rest afterwards.

Prof. J. P. Jackson said that the ideal method of education is to give the boys a good four years' high school or academy course; a four years' college course, which runs along in the same way, but specialize, possibly, a little, and then give them a post-graduate course, say of two years. As most of the boys who would like to go through such a course are poor, manufacturing or operating engineering concerns should put something like a premium on such an extended course; this would have a tendency to uplift the whole scheme of education.

Prof. Kent said Mr. Osborne required too much from a graduate. Prof. D. C. Jackson considered himself too old-fashioned to agree with the radicalism of Prof. Franklin and Prof. Goldsborough. While he also is an ardent opponent of the spectacular in the teaching of physics and engineering, he claims it is of advantage to call the student's attention to the wonder of the great unity, the great continuity and the extreme persistence of nature and the way in which nature's laws are always fulfilled. He emphasizes the college should teach principles, not technical details.

TYPICAL COLLEGE COURSES DEALING WITH THE PROFESSIONAL AND THEORETICAL PHASES OF ELECTRICAL ENGINEERING.

Prof. Dugald C. Jackson, of the University of Wisconsin, presented a paper on this subject, after the meeting had been turned over to the Society for the Promotion of Engineering Education. He referred to the prejudice which formerly held against college men in the minds of so-called practical men. This old prejudice, so far as it exists, has now more particularly drifted into the way of criticism of the engineering schools rather than of the graduates. It is the business of the engineering college to produce, not finished engineers, but young men with a great capacity for becoming engineers. The problem to be met by the engineering colleges is more particularly a problem in "how to properly train" to the stated purpose. It is a teacher's problem rather than of the engineering profession. It must be met with all the directness and power of the engineer's best efforts, but it cannot be solved as solely relating to the engineering profession. Much error on this point lies in the minds of many who assume the part of critics of the curricula of the engineering schools.

The author discusses the question, What must the ideals of education consist of and how fairly should they be met by the college before its course in electrical engineering may be approved as of first rank? Electrical engineering demands industrial engineers; to reach his highest influence, each man must combine in one, a man in the physical sciences, a man in sociology and a man of business. This result must be achieved by a college in four years. Michael Faraday, whose conservatism and intellectual clearness are proverbial, said that it requires twenty years to "make a man" in the physical sciences. Hence the college can only lay the foundations of "the man."

The boys entering an engineering school from a high school or a preparatory school, are well equipped with physical vigor and latent mental strength. The electrical engineering course must include the following branches of learning, which are preparatory to the more strictly professional studies: A further training in the English language which is requisite to clear thinking or clear writing; the collateral art of expression in drawing; mathematics through an appropriate amount of calculus, with special emphasis laid on interpreting the meaning of equations; chemistry and physics, soundly taught; applied mechanics. Mechanics, the philosophy of matter, force and energy, is the backbone of the electrical engineer's college training. This ground cannot be covered with anything like reasonable success in much or any less than three years.

After covering these branches it seems to be the tendency in many colleges to fly off into superficial or descriptive courses relating to engineering practice. But this is absolutely wrong, as a resort to descriptive courses of instruction during the latter portion of the student's life in college largely neutralizes the advantage flowing from the instruction in the fundamentals before described. The students must now be taught many things relating to engineering life. The electrical engineering department should be divided into four subdivisions: applied electromagnetism, including dynamo machinery; the theory and practice of all those phenomena which accompany variable current flow; applied electrochemistry and electrometallurgy, and electrical installations. But through all this professional instruction of the latter part of the course, it is still principles, principles, principles, and rational methods of reasoning which must be taught, if full justice is done the students, until each student becomes a man of open mind, keen observation, analytical thinking and accurate powers of inference. This instruction should be kept close to the tests of good practice and the senses of the student should be constantly stimulated by illustrations and problems drawn from practice.

Students who have gone through such a course are not likely to enter immediately into positions of much responsibility, but rather go into the so-called "cadet" positions or "student" positions of great industrial enterprises for the purpose of gaining that experience in the crafts which may enable them to make the most extended use of their training in principles. Here they gradually find themselves and ultimately reach the influence in the industrial world for which their calibre and training fits them.

Niagara State Reservation and the Falls.

The annual report of the Commissioners of New York State Reservation at Niagara, just issued, is an interesting and voluminous document. Regarding the use of water from Niagara River for power purposes, the report says that the danger which threatens the integrity of Niagara Falls is not merely theoretical, but is a very substantial reality, and proceeds from three sources:

First, from the power companies now in operation on the American side, which take from the Niagara River between 7,000,000 and 8,000,000 gallons of water a minute, or about 6 per cent. of the total flow over the falls.

Second, from the construction of commercial and drainage canals, which will divert the waters of the Great Lakes from their natural outlet by way of the St. Lawrence system to that of the Mississippi. The Chicago drainage canal, designed to take 600,000 cu. ft. a minute from Lake Michigan, is a case in point; and among other suggestions which have been advanced is one for a canal across the State of Wisconsin from Lake Michigan to the Mississippi, and another for a canal from Lake Superior at Duluth to the Mississippi.

Third, from Canadian enterprises, like the Welland Canal and the proposed canal connecting the Georgian Bay with the Ottawa River; or, to come nearer to Niagara, from the Ontario Power Company, and the Canadian Niagara Power Company, whose works are now in course of construction within sight of our reservation, and from a third Canadian corporation to which the Commissioners for the Queen Victoria Niagara Falls Park have recently granted a similar privilege.

New Telephone Patents.

SPECIAL SUBSCRIBERS' LIST.

A few weeks ago a patent was issued describing a special subscriber's list arranged for mounting upon the face of transmitters and ruled to provide spaces for the names and numbers of subscribers frequently called. Another device of the same general type is that invented by Joseph P. McKee, of Allegheny, Pa., and patented under the title, "Telephone Notation Register." This device also clamps upon the front face of the transmitter, but the number chart is circular and divided into sectors by radial lines. Each of these sectors is of a size to accommodate one name and number. The number chart, which is rotatable, is concealed behind a stationary metal disc having an opening exactly corresponding to the number sectors. Behind this opening the desired name and number may be made to appear by rotating the number chart.

PREPAYMENT INDICATOR.

Present practice where automatic or coin collecting pay station devices are used, requires the operators at the central office to listen

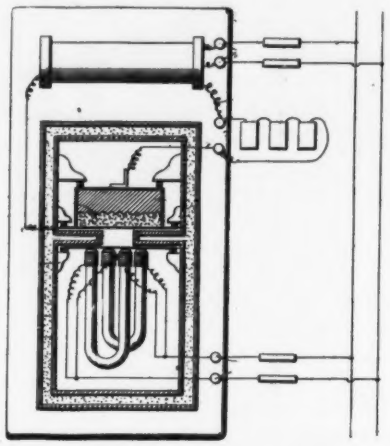


FIG. 1.—SAMMONS TELEPHONE REPEATER.

upon the lines in order to ascertain when a coin has been deposited. Two general methods have been available for determining the denomination of this coin. With one the coin sounds characteristic gongs or bells, while with the other the electrical circuits are automatically made and broken a different number of times for each different coin. The present invention, the work of R. B. Hazlett, of Philadelphia, is for use with pay stations of the latter type and provides an indicator with a step-by-step mechanism which registers visually before the operator the making and breaking of the circuit. By suitably marking the dial the operators can tell at a glance the total of all coins deposited. When a collection has been properly indicated, the pulling of a knob allows the pointer to restore to zero so that each collection may be independently and directly indicated.

TELEPHONE REPEATER.

In Fig. 1 is shown a telephone repeater which has been patented

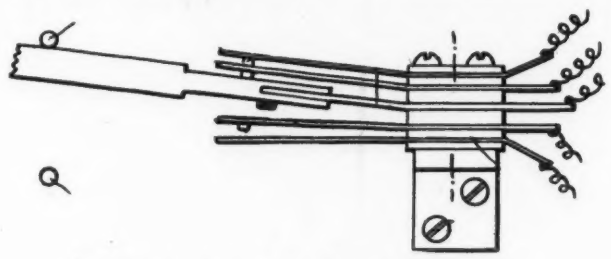


FIG. 2.—FAHNESTOCK HOOK SWITCH.

by O. P. Sammons, of Denison, Texas. This is of the transmitter-receiver type. Within a sound proof-case a double horse-shoe magnet carrying four bobbins is mounted. This with the diaphragm near the bobbins composes the receives. Just above is mounted the transmitter with its diaphragm. Both diaphragms are supported upon soft jackings in such a manner as to form between them a sound chamber the equivalent of the ordinary mouthpieces. Although this device will undoubtedly be operative when wired as shown in the patent, if the line wires be broken between the receiver and transmitter taps, it will be operative in one direction. It is not possible to imagine it a successful repeater, however. Many earlier attempts have been made to use such apparatus and all have failed because of the poor quality of the speech transmitted, the quality or clearness being as much or more essential than volume.

HOOK SWITCH.

The hook switch which has been the subject of invention and improvement ever since its inception has received additional modification at the hands of E. B. Fahnestock, of New York City, who has obtained a patent for the switch shown in Fig. 2. As will be noted, the switch springs are mounted in a manner akin to that found so successful in switchboard keys. The middle spring serves as a hinge for the hook to which it is riveted, and it also serves as the hook lifting spring. The two upper springs engaging with each other and the hook shank control the talking circuits, while the lower two springs operated by an insulating stud control the bridging bell circuit. This switch should be cheap to manufacture and fairly positive in action.

TRANSMITTERS.

The granular carbon transmitter continues a subject for many inventors. Patents for four novelties in this line have recently appeared. The objects which the various inventors have in view include the overcoming of almost every known transmitter trouble.

The first of the new transmitters to which consideration will be given is that shown in section at the right of Fig. 4. This is an improvement of that type of instrument in which reed resonators are provided tuned to the notes of the chromatic scale. Such a transmitter was described at length in these columns some weeks ago. Unlike this earlier instrument, the present one has a diaphragm of the usual type to supplement the vibrators. It has in addition—and this is the point upon which the present patent focuses—a plate resonator so supported upon the movable electrode stud as to lend its sympathetic vibrations as an aid to those set up by the diaphragm and reeds. This improvement has been added by Fred C. Redfield, of Nashua, N. H.

At the middle of Fig. 4 is shown a sectional view of a transmitter of which the principal aim is the isolation of the metallic diaphragm from the electrical circuit. To this end the diaphragm

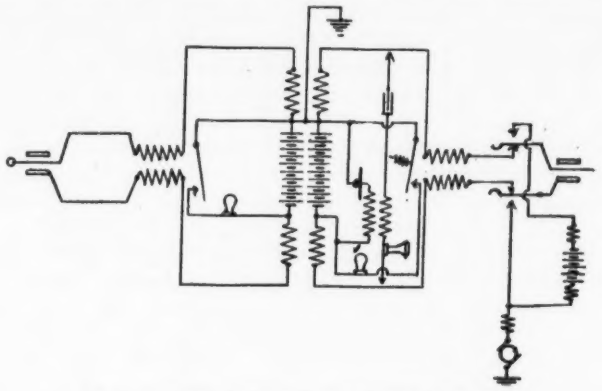


FIG. 3.—MILLER CENTRAL ENERGY SYSTEM.

is mounted upon an insulating cushion and the dampers bear upon insulating cushions. Upon the rear side of the diaphragm a thin carbon plate is mounted. This forms the front or movable electrode, and as the circuit wiring is attached to this carbon plate, the metallic diaphragm is entirely omitted from the circuit. The arrangement of stationary electrode and adjustments are self-evident from the figure. Mathias Weiser, of Milwaukee, Wis., is the inventor of this transmitter.

E. B. Fahnestock, of New York City, has obtained three transmitter patents. The transmitter shown at the right of Fig. 4 is the subject of one of these. Diaphragms proper are wanting, but the circular faces of the carbon chamber both consist of mica discs carrying carbon electrodes. These discs serve as diaphragms. Adjustment is obtained by weighting up the micas with discs of metal, the exact weight required for any case being obtained experimentally.

Mr. Fahnestock's second patent provides a transmitter in which the electrodes are inclined to the horizontal. The friction between the granules and electrodes is thereby increased and thus the tendency of the granules to work together in the lower part of the carbon chamber, i. e., packing, is retarded. Furthermore, the carbon button is mounted within a square frame of metal, and this fact coupled with a proper design of electrical connections makes it possible to quickly remove the button, rotate it through 90° and to

replace it. This act brings the packed side up and in position to effectively unpack itself.

The third patent granted to Mr. Fahnestock describes a clamp for horizontal transmitter arms, such as are used with wall sets. In this clamp the usual cast clamping lips are replaced by sheet spring lips, about the bases of which the clamp base is cast. This results in a strong but easily constructed clamp.

IMPROVEMENT IN KELLOGG TWO-WIRE SYSTEM.

Mr. Kempster B. Miller has made an improvement in the cord circuits for the Kellogg two-wire central energy system. In this system it will be remembered that the subscriber's line is normally disconnected from the jacks. A relay permanently wired to the jacks serves to connect the subscriber's line in parallel with its own high impedance coil whenever a plug is put into the jack. With this system it has been heretofore possible to open but one side of the line toward the calling subscriber when ringing. This is because one wire was continually required to supply current to the controlling relay. This difficulty has been overcome by Mr. Miller by the arrangement of circuit shown in Fig. 3. Here it will be seen that a special battery connected between impedance coils is substituted for the talking battery upon the depression of the double cut-off ringing key. By this means the alternating ringing current is kept in its proper course to the subscriber's bells, while the calling subscriber has no indication of the ringing current.

SELECTIVE SYSTEM.

A selective system of ringing has been patented by A. J. Springborn, of Cleveland, Ohio. Unfortunately selection depends upon the synchronous action of electrically wound clockwork mechanisms at not only all stations but at the central office. The difficulties of such a system are too well known to need mention and are of a nature such as to warrant the omission of any detailed description of the circuits and apparatus.

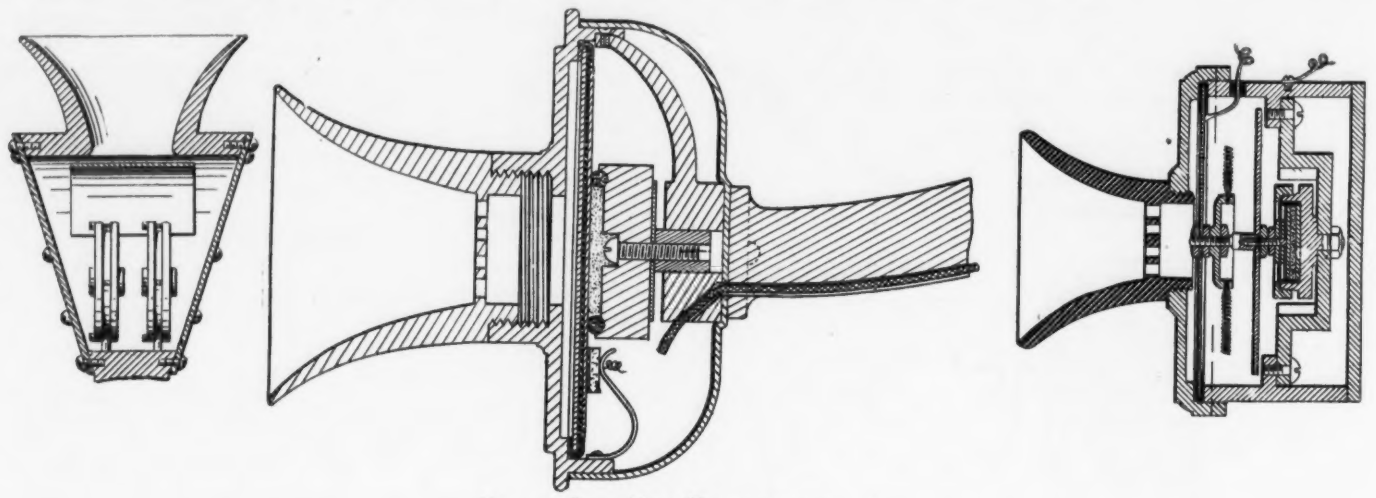


FIG. 4.—SOME NEW TRANSMITTERS.

Subway Under Broadway, New York.

The New York Rapid Transit Commission's special committee, to which was referred the application of the Interborough Rapid Transit Company for permission to connect the Forty-second Street and Union Square stations of the subway by a tunnel under Broadway, at a meeting on July 10, decided not only to report favorably upon this scheme, but to recommend the building of a subway under Broadway from Forty-second street to the Battery. Chief Engineer Parsons was directed to begin the preparation of plans for a tunnel the whole length of Broadway below Forty-second Street. Mr. Parsons said he would have the plans ready by October.

While the contract for the Broadway route will have to be put up to public competition there can be but one bidder, since the city is committed to the policy of a single fare over all the underground lines.

Mr. Parsons said that he could not say whether the Broadway tunnel would be a two or a four-track route, nor was he ready to give any opinion as to whether it would join the tracks of the Brooklyn extension at the Manhattan post-office.

It is probable that some provision will be made to connect the new road with the Pennsylvania tunnel by a tunnel for the shuttle cars from a station at Thirty-fourth Street and Broadway.

The committee decided also to approve the plan of joining the East Side subway line with the Third Avenue elevated road at One Hundred and Forty-ninth Street and Westchester Avenue.

CURRENT NEWS AND NOTES.

THE TELECHIROGRAPH.—We are informed that since the article on the Telechirograph appeared in our columns (in the issue of June 20) the apparatus has been worked over a resistance corresponding to 185 miles of line. Telephone messages were sent simultaneously with telegraphic messages, the voltage being 15.

ALASKA TELEGRAPH LINES.—A dispatch has been received at the War Department at Washington, from Capt. Burnell, at Dawson City, reporting that the military telegraph line in Alaska, which was completed June 24, had been partly destroyed by forest fires before it could be put in operation. It will take about a month to repair the damage.

TROUBLE OVER A CABLE IN CHINESE WATERS.—A dispatch from Tokio to the London *Times* states that the Russians laid the cable between Antung and Yongampho without consulting Korea. Japan protested, since the convention between Japan and Korea binds Korea not to allow any foreign power telegraphic power interfering with Japan's vested interests.

WIRELESS IN ALASKA.—A telegram of July 3 from Tacoma, Wash., says: "Without depending on contractors, the United States Signal Corps itself will erect and equip government wireless stations in Alaska. The first station will be constructed at Fort Davis, Nome, comprising one mast and quarters for three telegraphers. The next post will be at Safety Harbor, twenty miles south of Nome, where two masts and quarters for four men will be installed. Another wireless post will be placed at St. Michaels. Wireless stations to be established in Ontario will comprise masts and buildings at Fort Piggons and Bates Rapids, connecting a land line from St. Michaels with Fort Egbert, and also with a line through Copper River Valley to Valdez, where a submarine cable will connect the Alaskan system with Puget Sound."

INDEX OF THE TECHNICAL PRESS.—The Association de la Presse Technique, 20 Rue de la Chancellerie, Brussels, Belgium, has issued the third number of a monthly publication indexing the articles of greatest technical interest appearing in periodical publications in the English, German and French languages. The June issue contains 1,714 entries, giving the title with a characterization of contents, the name of the author, the source, date of publication and number of words. The matter is printed on only one side of a sheet, and as the paper is thin, clippings may be pasted on a card for filing. The index entries are in the languages in which the article is written, those from English periodicals being in English, in French when the article appears in a periodical printed in that language, and similarly with respect to German. The briefs are well prepared and the publication should be of much value to those who keep up card indexes of technical literature, as well as to many others. The subscription price is 5 francs per annum.

TYPESETTING BY TELEGRAPH.—A cable dispatch from Paris of July 4 says: Prof. D'Arsonval this week submitted to the Academy of Science an invention for typesetting by telegraph, the electric current being made to perforate characters on a moving band connected with a typesetting machine. It is claimed that the contrivance, which is the work of M. Rodmal, will dispense with transcription altogether for press purposes.

ELECTRICAL UNION ENJOINED.—Judge C. Ray, of the Hennepin County (Minn.) District Court, has granted an injunction against the Electrical Workers' Union. He holds it to be illegal for the strikers, first, to conspire to injure the contractors' business; second, to interfere with such business by threats directed against customers or prospective customers; third, to notify customers that contractors are "unfair"; fourth, to go on premises where contractors are employed to interfere with their business, and fifth, to order union men to quit work on premises by reason of the fact that contractors may be employed thereon. This injunction is temporary, and it is said that unions will fight it to the court of last resort.

STRIKE IN A TELEPHONE FACTORY.—A strike was declared May 4 by the workmen employed in the factory of the Kellogg Switchboard & Supply Company, the course of which has been marked by much violence. There were 927 employees at the time of the strike, and of these 700 quit work. For several weeks the shops were practically closed, and when the company began to hire men the pickets became so aggressive that an injunction was asked for and granted, restraining the strikers from interfering with the business or the employees of the company. There have nevertheless been numerous assaults on employees. A few days ago Julius Glant, cashier of the company, was attacked by men with billies and brass knuckles and dangerously injured. The victims thus far number over 45, including a woman employee.

MULTIPLE UNIT CONTROL.—A patent granted on June 30 to Mr. Elmer A. Sperry, of Cleveland, Ohio, on an application filed September 14, 1898, describes a system of control for electrically-propelled trains. Each car is a self-contained unit, i. e., has its own motor contact device, controller and "master controller," which is used for regulating the action of the motor controller. These devices are connected to a cable and when the cars are united to form a train the ends of the cables are united so that corresponding wires are connected. The master controllers are connected to the cable in multiple and are so arranged that any one of them may be employed to regulate the speed of the train through the medium of the motor controllers. Since the motor controllers are regulated by electrical means and since the source of supply from a trolley or third rail is subject to interruptions, he uses a separate source of power for the regulating means. The cylinder of the motor controller is actuated both forward and back by means of a spring pilot motor, which consists of a spiral spring so arranged that it tends to unwind from both ends. In order to restore energy to the spring, a small electric motor is provided which is arranged to automatically start into operation as soon as the spring unwinds to a certain extent.

SINGLE-PHASE INDUCTION MOTOR.—Among the patents of July 7 is one on an alternating-current induction motor, issued to Charles S. Bradley on an application filed October 7, 1895, the patent being assigned to the General Electric Company. The motor is of the single-phase, split-phase type, two currents differing in phase being developed from a single-phase current by the employment of a condenser. These currents pass through coils angularly displaced on an annular core, and their joint action sets up a rotary field. After starting the reaction of the closed-circuit armature steadies the field and the motor runs with fairly uniform torque. The condenser is stored in the base of the motor and the field core is toothed, the notches being so disposed that the coils corresponding to the two current phases overlap. The windings are arranged to produce a multipolar field so that commercial rates of alternation may be employed. The winding which includes the condenser is of higher inductance than its companion winding to admit of the use of a comparatively small condenser to cooperate with the increased voltage in the condenser branch and to admit a better cooperation of the two windings. To accommodate the great number of conductor turns in the condenser winding the slots in the core which it occupies are made of greater capacity.

DYNAMITING AN ELECTRIC PLANT.—Early on the morning of July 5th a daring attempt was made to blow up the main generating station of the Colorado Springs Electric Company, located about four miles outside of the city of Colorado Springs, Colo. What saved the plant was the premature explosion of a stick of dynamite, which scattered the remaining 149 sticks of 1½-in. dynamite, weighing 75 pounds, that had been intended to do the work of destruction. Had the dynamite exploded the entire station would have been wrecked and it is also probable that 17 lives would have been lost, as five men were in the building at the time and 12 men were sleeping in a cottage adjoining the station. This power station supplies all the electric light used in Colorado Springs, Colorado City and Manitou, as well as furnishing all the electric power in Colorado Springs and vicinity, including the supply to the Portland, Telluride and Standard Mills in West Colorado Springs and Colorado City. The power circuits supply a three-phase, 6,600-volt current. General Manager George B. Tripp says he is at a loss to account for the cause of the accident. On the following night two attempts were made to short-circuit the main feeder by throwing obstacles over the wires.

LETTER TO THE EDITORS.

The Metric System.

To the Editors of Electrical World and Engineer:

SIRS:—I am loath to trespass further on your valuable space, and certainly far from wishing to dispute the editorial divine right to the last word on every subject; but your editorial of July 4 presents some further considerations concerning which a word or two further on the subject will not be amiss, inasmuch as on this one subject you are evidently still in the last century.

It is obvious that you do not yourselves appreciate the full significance of your pregnant remark that "the electrical engineer is of the younger generation, ... and to him the utilitarian past is without interest beyond the lessons it holds for the present and for the future"; but it unavoidably recalls the caustic satire of a German writer: "Every 30 years a new generation comes into the world, which knows nothing and proposes to summarily assimilate the knowledge of all the ages and then know more than all past time put together. For this purpose the youngster betakes himself to the universities and goes in for the latest books. Nothing for him but what is short and new!—he is new himself. Then he lets loose his opinions on the subject."

The sentence just quoted from your editorial would, in fact, furnish a text for a sermon on our side of the question. It shows that the "utilitarian past" is just what you metricists completely lose sight of in your ethereal flights, which render so fitting the characterization of the system you extol as "a long chain having the solar system at one end and a quart measure at the other." Your exception of "the lessons it holds for the present and the future" is to you no exception, for it is these very lessons, stretched out over a hundred years of dreary and disappointing experience, of governmental convulsions, of foolish and frantic efforts, and all for a very trivial, purely theoretical and withal puerile object—a meddlesome intervention of mathematicians in a purely administrative matter—these very lessons, I say, which we, myself and many others, have laid before you, and to which you turn a deaf ear. It is incumbent on every one, as Gibbon trenchantly said in his "Vindication," to read before he attempts to write, but it is patent from your remarks that you have not read the writings which you presume to criticise. Had you done so, it is impossible that you could continue to so misrepresent our position, or be so utterly impervious to the overwhelming mass of evidence on our side.

Now as to the electrical units: If, as you claim, the watt is a metric unit, how does it come that it is related to the real metric unit of power, the kilogrammeter per second, in the ratio 0.1019 ± Is this one of the "beautiful correlations" of the metric system? It is admitted that the "ridiculous old unit" now used "is only perpetuated by electrical engineers . . . . . *in order to meet commercial requirements.*" What superb condescension!—equaled only by that of the original system-mongers, who condescended to give their system to the world of commerce. The watt, then, does not meet commercial requirements—any more than the metric system and its units.

I venture to prophesy, and that, too, with confidence, that as soon as you can be prevailed upon to study our side—say five or ten years from now—your Editorships or your successors will be "on the fence" in this question, as many formerly metric papers are now; and that in ten or fifteen years you will be on our side of it—in other words, that you are only five or ten years behind the times in this matter. Meanwhile, all we ask is fair play, and may the best system win. Live and let live. Use the metric system all you want, and let others use theirs. Let the government alone—it is no "dog" to try nostrums on, as proposed by Mr. Southard, of the Coinage Committee. Remember, Congress has no power to enforce any system on the country—particularly an unwilling country. And finally, do not, while disavowing attempts at compulsion on the one hand, foster or promote compulsory laws on the other. The discussion of the past six months has had at least this good and profound effect, that it has wrung from metricists of all colors and degrees a unanimous disavowal of compulsory laws. This done, Mr. Southard and his committee find themselves suddenly high and dry, abandoned by their backers, and the whole agitation explodes in a farce.

MONTREAL, CANADA. GEORGE W. COLLES.

DIGEST
OF
CURRENT ELECTRICAL LITERATURE.

DYNAMOS, MOTORS AND TRANSFORMERS.

Non-Synchronous Alternating-Current Generators.—FELDMANN.—An abstract of a paper read before the Cologne Electrical Society. After discussing the action of such generators in practice, he states that they afford a possibility of running alternators in parallel and as boosters. When the Heyland collector is suitably furnished with the main current, besides the shunt excitation, the non-synchronous dynamos cannot only be compensated, i. e., made self-exciting, but can also be compounded to a quite constant potential, which even increases with the load. Such compound generators, as constructed by Brown, Schuckert, Lahmeyer, Siemens & Halske and the A. E. G., have less slip the greater the compounding is. They can, therefore, be employed in central stations in place of the synchronous machine necessary for maintaining the frequency. The running of such a central station would be comparatively simple, especially if the larger motors connected to it were also fitted with the compensating device so that they would not take any more wattless current from the mains. The author states that it would seem as if this new type of generator would become of considerable importance in practice in the near future.—*Elek. Rundschau,* June 1.

REFERENCES.

The Electric Motor as Traction Motor.—NIETHAMMER.—An article the first part of which contains a condensed enumeration of the different kinds of motors used on surface lines, elevated railroads, suburban roads, mountain railroads and large railroads, with their uses and advantages. In the second part the author gives his reasons for preferring direct-current motors to triphase alternating-current motors and quotes other continental and American engineers in support of his views.—*Ziet. f. Elek.,* June 13, 21.

Care of Induction Motors.—WEEKS.—An article on the inspection and care of induction motors in a large factory.—*Lond. El'ty,* June 12.

LIGHTS AND LIGHTING.

REFERENCE.

Alternative Connection of Triplex Arc Lamps in Three-Wire Circuits.—MIRAM.—The author gives a scheme for the connection of 5 lamps in a three-wire, 2 x 110-volt circuit, so that one group of two, 2 groups of two, and the fifth one may be connected and disconnected at will.—*Elek. Anz.,* May 28.

POWER.

Proposed Transmission for Power Purposes.—HICKS.—A long illustrated article on a proposition for the generation of power from the waterfalls of the Sierras flanking the San Joaquin Valley, Cal., and its utilization, through electric transmission, for pumping the irrigating water supply in the valley. Three pipe lines are designed to be 30 in. in diameter, of steel plates riveted in place, with full load velocities of 7 ft. per second and an effective head of 660 ft., requiring a flow of 100 cub. ft. per second to generate the rated output of the dynamos. The generators proposed, three in number, are of the three-phase, 60-cycle, alternating-current, revolving field type, with a normal capacity of 1,350 kw, or 1,800 hp, at 2,200 volts, at a speed of 200 r.p.m., and are on the shaft with the water wheel. The current is transformed up to 30,000 volts and transmitted to transformer stations. A detailed estimate of the cost is given. The author estimates that the annual amount of water available from the new supply would be 300,000 acre-ft., which will then be available for cultivation. —*Jour. of Elec. Power and Gas,* June.

Electric Cranes.—HEAD.—An abstract of a paper read before the recent London meeting of the Institution of Civil Engineers, dealing with the speeds of overhead and other cranes as a factor in economic handling of material in working. The author deals almost exclusively with electric cranes, and states that electricity is rapidly displacing all other forms of power transmission for cranes. Its advantages over hydraulic power are its greater economy, ease of transmission, flexibility and less liability to trouble from changes of temperature. The advantages of greater simplicity and precision possessed by hydraulic power, are being rapidly neutralized by improved electrical appliances and methods of manufacture. The most suitable form of energy is stated by the author to be direct current at 220 to 500 volts, this being superior to alternating current on account of the greater starting torque and acceleration. The operations of a crane involve a rapid succession of startings and stoppings; continuous running occupies an unimportant fraction of the time and loads are very variable. Series-wound motors, which automatically run faster with light loads, should be used, if they are coupled permanently to the gearing. They should withstand 100 per cent. overloading for short periods and much higher overloads momentarily, without damage, which conditions are fulfilled by motors of the ordinary tramway type. Where motors run continuously with clutch connections to the gearing, they should be shunt-wound. The author then considers in detail the best working conditions and electrical equipment for fixed jib cranes, fixed rotary cranes, overhead traveling cranes, gantry and cantilever cranes and locomotive cranes. A table of speeds for electric overload traveling cranes of various capacities is given, for hoisting, cross-traversing and longitudinal traversing.—Lond. *Engineering,* June 19, and Lond. *Elec.,* June 19.

Motor-Driven Turret Lathe.—An illustrated description. The motor is mounted at the rear of the bed and not on an extension formed on the cabinet or box leg, the motor shaft and spindle being connected through spur gearing. The motor is of the variable-speed type, with a moderate range of speeds varying from 1,150 to 1,850 r.p.m. A large proportion of the speed changes are obtained through the gearing in the head.—*Am. Mach.,* July 2.

Plate-Straightening Rolls.—An article, illustrated with drawings in the text and on a plate, describing a new heavy machine for straightening hot plates 1.6 in. thick, cold plates 1 in. thick and 13 ft. 7½ in. wide. Power is furnished to the machine by an electric motor of 85 hp. The bottom rolls are driven by a separate reversible motor of 30 hp. The vertical adjustment of the top rolls is effected by means of a screw, driven by a 25-hp motor.—Lond. *Engineering,* June 19.

Electric Drills in Mines.—A long editorial discussing the principles of the construction of and the objections against, electric drills. It is stated that there is the expression of an earnest hope among mining engineers, that the electric drill may become a practical success in mining, and that there are reasons for believing that it will be fulfilled. There is also a communication by a correspondent on this subject in the same issue pointing out the objections to the use of the Siemens & Halske drill and hoping that the electric drill will be perfected, as its field of usefulness is manifest.—*Eng. & Min'g Jour.,* June 27.

TRACTION.

Traction by Accumulators.—An article on traction by means of accumulators on the Meridional Railways of Italy. The cars have seating capacity for 64 passengers, and the body is mounted on two four-wheel bogies, one axle of each bogie being driven through spur gearing by a 50-hp electric motor. The two motors of each car are in series and the gearing is in the ratio of 1 to 6. The battery is carried under the car; it weighs about 3 metric tons and comprises 266 cells, arranged in three groups of four boxes, or 12 boxes in all. The 12 boxes can be withdrawn by two men in 10 minutes; they are only entirely withdrawn when it is necessary to renew the plates; for recharging and inspection they are only partially withdrawn. Each charge of the batteries corresponds to 4,410 km-tons (car weight complete, 52½ tons; distance on one charge, 84 km), and requires on the average 104 kw-hours. The consumption of energy at the power station is 23.6 watt-hours per ton-km. The energy efficiency of the battery on the Bologna-Modena line has been found to be 57 per cent.; the normal speed is 28 miles per hour and the maximum 33¼ miles. With regard to the life of the battery, it has been found that the positive plates last for an average of 6,875 miles, and the negatives for double that distance. The cost of plates works out at 24 cm per km, or .00456 cm per ton km. The inspection, electrolyte and repairs cost during the first year 12 cm per km, or .00228 per ton-km. —Lond. *Elec. Rev.*, June 12.

Notes on Sub-Station Practice.—An article in which the writer points out factors which must be considered in the construction and location of sub-stations, which must be an accompaniment of all roads where alternating-current distribution is employed until alternating-current motors are developed. The first point is central position with reference to the load distribution. This should not be based simply on the existing load, but the engineer should consider the distribution which will be required in the future, the possibility of double-tracking, etc. A careful calculation should then be made of first cost and operating economy for the different proposed locations, for several schedules likely to be adopted. The various considerations underlying the selection of the location, both for technical and administrative reasons are discussed. Concerning the design and construction, it is claimed that the station should be of brick, and fire-proof as far as skill can make it. Complications in wiring should be avoided, as also all possibility of moisture where the high-potential wires are carried down into the station. The insulators should be the same on the line and within the sub-station, and all low-tension wires should be kept away from high-tension wires. The high-tension wires should be run in plain sight, if possible, and the low-tension wires under the floor. It is usually possible to arrange the high-tension wiring so that a person standing in one place in the sub-station can see the wiring and machinery without leaving his position. If storage batteries are used, care must be taken that the acid fumes do not reach the electrical machinery. Arrangements should be made for making it possible to cut the sub-station out of circuit in case of an interruption of the supply. The sub-station should have a telephone in a sound-proof box, located so that the operator can see the switchboard instruments while using the telephone.—*St. R'y Jour.*, July 4.

Berlin-Zossen Railway Tests.—An editorial referring to some recently published results of tests on this railway. Figures given in a Belgian paper confirm the opinions and results which have already been published. The method of taking current, even at 100 miles per hour and at 13,500 volts, presented no trouble, so that current collection need not be considered among the material difficulties of working at very high speeds with high voltage. It is also to be noticed that the cars ran much smoother at about 130 km an hour than they did at 100 km an hour, showing that there is a marked steadying effect at high speeds that materially lessens the tractive resistance. The comment is made that the acceleration was very low and the tests would also indicate that the traffic problem will be a serious one at high speeds. The power required was satisfactorily low, showing that there is no difficulty in this particular. In other words, this latest report tends to confirm the opinion, justified by the earlier ones, that the electrical difficulties have been overcome, and that the only difficulties now in the direction of high speed are from a mechanical standpoint.—*St. R'y Jour.*, June 13.

Electric Railway for Freight and Passengers.—A long illustrated article describing the Lackawanna & Wyoming Valley Railway, which is noteworthy on account of the terminal facilities provided, the heavy track construction and other provisions in the equipment for high-speed and heavy traffic. The main line will connect Scranton with Wilkesbarre, and an extension will be built to Carbondale, passing through the most prosperous section of the anthracite district in Pennsylvania. The entire line when completed will be about 37 miles long. A general description of the engineering features of the road is accompanied by a number of illustrations.—*St. R'y Jour.*, June 13.

Improvements on the Cleveland & Southwestern Interurban System.—An illustrated article describing a railway property which is interesting, especially as an example of a system built up piecemeal to answer the demands made by thriving towns in the neighborhood of Cleveland for better communication with that city. Only one line enters Cleveland, but beyond the city it spreads out like a huge fan, touching all the towns in a southerly and westerly direction within a radius of 50 miles. At present there are 7 divisions or branches of this road, and extensions now building will make it one of the most extensive systems of interurban electric railways in the country. The roadbed and overhead work are of standard construction, and the rolling stock is all built especially for interurban service. The main power station is located at Elyria, and when this installation is completed will include two 1,000-hp Westinghouse turbines, directly connected to alternating-current generators. Additional units will be installed. Several sub-stations have been established, and others are now being equipped, the initial installation of each consisting of a 300-kw rotary-converter and three 200-kw static transformers, together with high-tension and low-tension switchboards, static interrupters and the usual equipment for this class of work. Pending the completion of the main power plant, current is furnished temporarily by 300-kw inverted rotary converters, which have been installed at the Elyria power house. Another interesting feature of the equipment is a combination freight car and snow plow. This car is designed so that the plows may be readily removed and the car can then be used as an ordinary freight car. A portable pneumatic jib-crane mounted on a single truck is used for general hoisting and handling trucks, wheels and other heavy material in the yards and repair shops. A comprehensive system of train inspection has been developed in connection with this property and the movement of cars on all of the 7 divisions is controlled by the dispatcher from the central office.—*St. R'y Jour.*, June 27.

Street Railway Power Plant.—JACKSON.—An illustrated article describing the Boston & Worcester Street Railway power plant. The electrical installation consists of one 500-kw and one 1,000-kw generator, two rotary transformers of 250 kw, 500 r.p.m., 6 poles, alternating-current voltage 360, direct-current voltage 600, at 417 normal amp.; 6 transformers of 100 kw, three for each rotary connected in delta, reactive coils are inserted in the secondary for compounding. There are two 35-kw, six-pole exciters and one 4-pole, 50-kw exciter, all running at 125 volts.—*The Engineer*, July 1.

Motor Repairs in Car Shops.—An editorial on the advantages and disadvantages of making repairs in the pits of car houses. It was formerly considered essential that a car house should have pits so that the workmen could examine the motors and other parts from below. It is thought by some, however, that good work cannot be carried on in a pit and two companies, in Milwaukee and St. Louis, have recently built car houses in which there are no pits. Here the motors and trucks are run out from under the cars and examined from above. In Milwaukee a special motor has been designed so that it can be inspected from above.—*St. R'y Jour.*, July 4.

REFERENCES.

Transportation Facilities at the Soo.—An article describing the system of the International Transit Company and the Trans-St. Marys Traction Company, both of which are controlled by the Consolidated Lake Superior Company. The construction of the road, the equipment and rolling stock is discussed.—*St. R'y Jour.*, July 4.

Accumulators for Traction Purposes.—V. WINKLER.—A theoretical article, in the first part of which the author proposes to answer the question to what extent the rate of discharge may be increased for the single plate, in order to obtain on the one hand the largest possible effect per discharge (light battery), and on the other hand the greatest total effect, which the battery can give during the total time it is in use. The question is treated with the help of diagrams. He then takes up the discussion of the most favorable number of plates for a cell and the arrangement of the whole battery, concluding with some observations on the motors for traction purposes.—*Zeit. f. Elek.*, May 31, June 7.

ELECTRO-PHYSICS AND MAGNETISM.

Secondary Radiation from Gases Subject to X-Rays.—BARKLA.—The author describes in detail the apparatus used and the experiments conducted for the investigations of the above subject. He arrives at the following conclusions: 1. All gases subject to X-rays are a source of secondary radiation. 2. The absorbability of the secondary radiation is (within the limits of possible error, which was about 10 per cent.) the same as that of the primary radiation producing it. 3. For a given primary radiation the intensity of secondary radiation is proportional to the density of the gas from which it proceeds—the temperature and the pressure being practically constant. 4. The secondary radiation is not due to the recombination of the ions. As the primary and secondary radiations differ appreciably in intensity only, the author thinks that we may reasonably conclude that the radiation proceeding from gases subject to X-rays, is due to scattering of the primary radiation. As this scattering is proportional to the mass of the atom, it may be concluded that the number of scattering particles is proportional to the atomic weight. This would then give further support to the theory that the atoms of different substances are different systems of similar corpuscles, the number of which in an atom is proportional to its atomic weight.—*Phil. Mag.*, June.

Electrical Conductivity of Atmospheric Air.—MCLENNAN AND BURTON.—The air, whose conductivity was to be measured, was confined in a cylinder 125 cm long and 25 cm diameter, composed of sheet iron coated with zinc. Measurements on the conductivity were made at intervals of a few minutes at first, and it was invariably found that a rapid decrease in the ionization took place, until a minimum value was reached. The conductivity then slowly increased and approached a limiting value in the course of two or three days. The authors also conducted a series of tests in which they confined the air under high pressures in a heavy rolled iron cylinder coated with zinc. They found in this case again the rapid decrease to a minimum followed by a gradual rise towards a limiting value. They explain these observed facts by the supposition that a radioactive emanation, probably having its origin in the earth's surface, was introduced into the cylinder with the air, the decay of this emanation being the cause of the decrease in the conductivity, and that the subsequent rise in conductivity is due to a radioactive emanation given off by the walls of the containing vessel. On this view the limiting value to which the conductivity curves tend, would represent a condition of equilibrium, where the rate of decay of the emanation was equal to the rate at which it was produced. To ascertain whether the conductivity of the enclosed air was affected by a change in the metal composing the walls of the receiver, linings of tin and lead were used. The curves for these metals were found to have the same characteristics; in each there is a rapid drop to a minimum and a gradual rise towards an ultimate limiting value. A considerable difference, however, was found in the minimum conductivities of the various metals and the final limiting values also varied. The authors state that, while these effects may be explained by supposing the ionization of the air to be caused by a radioactive emanation sent off from the metals, they have found that part of the conductivity cannot be accounted for in this way, but must be attributed to an active agent external to the receiver. The heavy cylinder mentioned above was filled with air to a pressure of about 400 cm of mercury and allowed to stand until its conductivity had become steady. It was then placed in an insulated galvanized tank, which was gradually filled with water. The initial conductivity before the water was admitted was 21.1. As the water rose in the tank, the conductivity decreased and fell to 13.3 when the tank had been filled. The values for the conductivity show that the loss was almost directly proportional to the rise of the water and the total fall in conductivity was about 37 per cent. The authors conclude from these results that the ordinary air of a room is traversed by an exceedingly penetrating radiation, such as that which Rutherford has shown to be emitted by thorium, radium and the excited radioactivity produced by thorium and radium.—*Phil. Mag.*, June.

The Wiedemann Effect in Ferromagnetic Substances.—HONDA AND SHIMIZU.—The authors conducted tests on nickel steel wires and ferromagnetic bars. The experiments were conducted in the following manner: 1. The circularly magnetizing current was kept constant, and the amount of twist due to varying the longitudinally magnetizing current was measured. 2. The wire was then stretched by different loads and the above processes repeated. 3. The longitudinally magnetizing current was kept constant and the amount of twist due to varying the circularly magnetizing current, was measured. Before each experiment the wire was carefully demagnetized by the passage of an alternating current of gradually diminishing intensity, which was found absolutely necessary to secure correct results. The results show that in nickel steel the amount of twist first increases until it reaches a maximum, after which it gradually diminishes. But the reversal of the twist is never observed, though the field exceeds 1,200 C. G. S. units. The tension always diminishes the amount of twist; the diminution is large in weak fields, and becomes gradually less as the field is increased. The diminution is approximately proportional to the applied tension. By varying the circular field it was found that under a constant longitudinal field the angle of twist at first increases at a constant, but later at a gradually diminishing rate. As the longitudinal field is increased, the curves approximate to right lines, according with Kirchhoff's theory. For iron bars the authors found that the general course of the curves is similar to that observed in a wire of the same metal. The direction of twist is opposite to that of nickel in weak fields and in strong fields the direction does not reverse. The direction of twist is the same in cobalt as in nickel, cast cobalt giving different results from annealed cobalt.—*Phil. Mag.*, June.

Conductivity and Dielectric Constant.—EVERSHEIM.—A preliminary article, with diagrammatic curves on some results obtained by the author in the investigation of the conductivity and the dielectric constant of solutions and solvent in the critical state. Experiments were conducted with ammonia, copper nitrate solution, sulphurous acid solution and carefully purified ethyl ether. The apparatus and details are promised in a later article. The following conclusions are drawn by the author: 1. The resistance of solutions and solvent grows continuously from a certain temperature, situated below the critical temperature and seems to take a constant value above that; whether this is the "absolute gasifying point" of Traube, demands a further investigation. 2. Also, the change of the dielectric constant from the fluid to the gaseous states takes place without jump. 3. The peculiar changes at the critical temperature, which have been observed in all substances under consideration, give rise to the supposition that they may be of a general nature and perhaps stand in the closest connection with the critical state. 4. The critical state is not marked by equality of density in the space containing the gas and the liquid, because the latter depends on the circumstances, for, as was proved in this and other investigations, it is only beyond the critical point that there is a possibility of equal density.—*Phys. Zeit.*, June.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Wireless Telegraphy.—POCHIN.—An abstract of a short paper read before the recent meeting of the Institution of Civil Engineers in London, with the discussion. The paper contains a condensed statement of the methods proposed for the solution of the priblem of isolation. The syntonic and the optical methods are discussed. Attention is called to the possibilities arising from the use of two or more radiators in suitable phase relation, to reinforce waves in a particular direction, or from a corresponding arrangement in the receiver, the creation of stationary waves or nodal areas and the employment of the earth's period.—Lond. *Elec.*, June 19.

Electric Waves.—MORTON.—A mathematical article on the connection between the speed of propagation and attenuation of electric waves along parallel wires. The author concludes that in systems which cause a given amount of retardation in the speed of the waves, the attenuation constant is proportional to the frequency; or, there is a constant logarithmic decrement in running a distance equal to the wave-length in free space, of oscillations of the same frequency. When the dissipation of energy in the wires is small the logarithmic decrement, on running the fraction $\frac{1}{2}\pi$ of a wave length, is equal to the fractional decrease of the speed of propagation. When the attenuation is rapid, it approaches the value 2π divided by the actual wave length along the wire.—*Phil. Mag.*, June.

In the Transmission of Photographs by Telegraphy.—KORN.—A note before the French Academy of Sciences, wherein the author gives a new method, based on the change in conductivity of selenium. The photographic film of the receiver turns before a small window in a blackened vacuum tube. Luminous radiations can be produced in the interior of this tube, which will produce, after having passed the window, photographic impressions on the sensitive film. The latter moves synchronously with the film carrier of the transmitter (a film with the photograph to be reproduced on it, rolled around a

glass cylinder), which is traversed by a very small bundle of light rays and passes, line for line, before a selenium cell arranged in the interior of the cylinder. According to the different shades of the photograph the selenium receives more or less light and an electric current produced by a constant e.m.f, passing through the selenium and the telegraph wire to the receiver, will receive corresponding variations of intensity and will regulate the intensity of the radiations of the receiving tube in the following manner: The active electrode of the tube is connected with a point, placed at a small distance from one extremity of the needle of a galvanometer arranged in the line wire, and a second point, situated near the other extremity of the needle is connected to one of the poles of the secondary of a Tesla apparatus. A flow of sparks jump over between the fixed points and the needle and the intensity of this flow is the greater, the nearer the extremities of the needle are to the points. By this arrangement it is possible to make the intensity of the radiations in the receiving tube correspond to the intensity of the light, striking the selenium of the transmitter and thus to reproduce the photograph line for line.—*Comptes Rendus;* abstracted in *L'Eclairage Elec.,* June 13.

Automatic Signaling.—CUDWORTH.—An illustrated abstract of a paper read before the last meeting of the English Institution of Civil Engineers, with the discussion. The first part of the paper is mainly historical; the author then proceeds to describe the systems now being installed on the North Eastern Railway and the London and Southwestern Railway. The latter is an electro-pneumatic system, differing, however, from those commonly used in the United States in that air at a pressure of 10 to 20 pounds per square inch is used, instead of 80 to 90 pounds per square inch. One power station situated near the center will serve for a distance of 23 miles. Pneumatic pressure is conveyed thence in pipes the whole length of the installation, with branches to all signals. Each signal arm is worked by means of a rod connected with a piston actuated by pneumatic pressure. The pressure is admitted to or withdrawn from the piston by means of a pin-valve actuated by an electromagnet in circuit with a signal battery, which again is under the control of the track battery circuit. The system being installed on the North Eastern Railway is the Hall system. Its general lines are similar to those of the London and South Western system as far as the track and signal batteries are concerned. Special appliances have to be added to effect the pulling off of the signals. The source of power is liquified carbonic acid, stored at a pressure of 800 pounds per square inch in two remarkable steel cylinders at the foot of each signal post. Each cylinder will suffice for 6,000 to 7,000 operations of the signal, the working pressure being about 50 pounds.—Lond. *Elec.,* June 19.

REFERENCES.

The Real Inventor of the Mercury Coherer.—GUARINI.—A note in which the author shows that Prof. Tommasina, of Genoa, was the first discoverer of the mercury coherer, which was used by Marconi for his first transatlantic experiments in December, 1901.—Lond. *Elec.,* June 19.

Improvements in Different Systems of Wireless Telegraphy.—PRASCH.—The continuation of the article previously noted in the Digest. The system of Anders Bull and several improved receivers, are described.—*Dingler's Polyt. Jour.,* May 30, June 6.

Wireless Telegraphy.—DE SEGUNDO.—A popular discussion of wireless telegraphy as compared with submarine cables, the author concluding that both methods have their own particular field.—*Page's Magaz.,* London, April.

MISCELLANEOUS.

Some Unsolved Problems in Engineering.—MAW.—A long abstract of the "James Forrest" lecture at the English Institution of Civil Engineers. The author dealt with the economical generation and distribution of power. Speaking about raising the efficiency of the steam engine, he thinks that the question of steam jacketing and especially the application of such jackets to compound or multiple expansion engines of modern types and of large powers, using steam at high pressures, deserves a much more thorough and systematic investigation. Another question is the extent to which our most advanced steam engine practice can, especially in the case of large power units, be improved by the use of superheated steam and the manner in which such improvement can best be realized. Equally desirable is the thorough investigation of the action of steam, both saturated and unsaturated, in the various types of turbine motors, in view of its great and rapidly growing practical importance. Attention is also called to various points connected with internal combustion engines, which also deserve investigation. Reference is also made to the new rapid tool steels, as being a series of materials, which promise to revolutionize a very important percentage of the machine work, and to necessitate very material alterations in the proportions of the machine tools.—Lond. *Elec.,* June 18.

REFERENCE.

Italian Machine Works.—A description of the Franco Tosi Works, Legnano, turning out engines and boilers. In the general machine shops electric driving is in use throughout, the total power being nearly 500 kw.—Lond. *Elec.,* June 19.

New Books.

THE UTILITY OF AN ACADEMIC OR CLASSICAL EDUCATION FOR YOUNG MEN WHO HAVE TO EARN THEIR OWN LIVING, AND WHO EXPECT TO PURSUE A COMMERCIAL LIFE. An Investigation. By R. T. Crane. Chicago, 1903. 110 pages.

The world would be a dreary abode if all men held the same opinions, and decided dissent from the majority even though absolutely at variance with the spirit of age, is apt to be refreshing to the jaded reader. Doubtless much of the vogue that the controversial writings of Ruskin had in their day was due to the antipodal views he took on the bearings of modern civilization, the material influences of which he denounced with all the vehemence of a rabid reformer fighting a great public evil.

These reflections rise from a reading of this little volume, which in its sentiments is almost as much at variance with the spirit of the present age as was Ruskin's ferocious antipathy to railways and other material developments that made the last century the golden age of mechanics. We may remark at once that so far as the author would deny systematic intellectual training to the young American, his attitude can only be likened to that of some southerners, who would narrow the life of the negro to the plantation field behind a mule.

The book contains a number of letters from educators and college graduates, and from business men who, like the author, have accumulated great wealth. The replies of the former apparently proved irritating to the author, for he exclaims, "I leave it to the public to judge whether the heads of these institutions have the proper appreciation of the importance of making accurate statements on this subject." College men apparently did not take very seriously the circular letter sent to them by the author, for he complains that only 555 replies were received from 1,593 letters sent out. From the replies received, 65 were selected as "from the class of young men whom I particularly desired to reach," and the author points out in apparent amazement that, "it is evident that 60 out of the 65 believe that the intellectual advantages coming to them from a college education are more valuable than financial success."

Neither do the replies received from business men seem to have been very satisfactory to the author, for he says, "even the replies of business men, as shown in the following pages, are often so indefinite as to be of no value for our purpose. No dependence can be placed on any of them who fail to make their practice consistent with their theories." The application of these remarks appears to be that some of the successful business men without early education, while not stultifying themselves by ackuowledging the advantages of such education, yet appear to have no personal objection to the educated employee. Of all men, however, from whom to obtain an unbiased opinion on the causes of success in life, the most hopeless subject is the successful man; for his view invariably appears to be that what was lacking from his personal career is not to be a factor of success for anyone entering a similar career, an irrefragible proof of which is the fact of his own success.

Such an inquisition, however, must necessarily be inconclusive when the testimony adduced is that of men whose success is rooted in the conditions of a past age. When the successful business men of the present day were young men, higher education was confined to those preparing for the professions and to the idle classes; and in those days the possession of a classical or academic education acted as a bar to the sympathy of employers and associates, while the methods of the day and all other conditions were against the

young college man who would enter the commercial or industrial field. At the present day, however, to ask us to revert to those times is like asking the naval architect to lay aside his scientific knowledge, discharge his drafting force and henceforth proceed to whittle models out of wooden blocks. To those in the electrical field who have witnessed the rise to dominance of the college man in that field, not only in the technical but in the commercial and manufacturing departments, and who see his present control of every avenue of advancement to such positions of profit he does not yet occupy, the hopelessness of the author's tilt against the conditions of to-day is as obvious as would be the case in an attempt to reproduce the material conditions of a generation ago.

As a further illustration of the author's attitude, we give below his remarks on the value of technical education, and particularly direct attention to his opinion that the mechanical millenium has been reached:

"The importance of technically educated men in mechanical lines of work, aside from electricity, chemistry and mining, has, in my opinion, been greatly overestimated. Many people who are unfamiliar with manufacturing seem to feel that there is a great field for such men in this kind of business, apparently forgetting that almost all the success which this country has gained along these lines of industry was achieved before technical men were ever heard of. They should realize that practically all branches of manufacturing business have been brought to such a wonderful state of perfection that there is very little chance for further improvement in them even by practical men who possess a large amount of experience, combined with good common sense. This being the case, there surely is no opportunity for the technical man, who is notably lacking in this latter qualification, to accomplish anything new in the mechanical direction."

Directory of Electrical Societies, Etc.

ASSOCIATION OF EDISON ILLUMINATING COMPANIES. Secretary, W. H. Johnson, Philadelphia, Pa.

AMERICAN STREET RAILWAY ASSOCIATION. Secretary, T. C. Penington, 2020 State Street, Chicago. Next meeting, Saratoga Springs, N. Y., September 2, 3 and 4, 1903.

INTERNATIONAL ASSOCIATION OF MUNICIPAL ELECTRICIANS. Secretary, Frank P. Foster, Corning, N. Y. Next meeting Atlantic City, N. J., September 2, 3 and 4, 1903.

THE ELECTRICAL TRADES SOCIETY (Member National Electrical Trades Association). Secretary, A. P. Eckert, 39 Cortlandt Street, New York. Board of Directors meets every second Friday of each month.

Underground Telephone System for Mexico City.

An extensive underground telephone system is to be constructed in the City of Mexico. The Compania Telefonica Mexicana (the Mexican Telephone Company), which concern already controls some 1,400 miles of telephone lines in the federal district, has secured the concession. Samuel Hernando & Co., of Mexico City, whose New York house is Samuel Hernandos & Cummings, 97 Front Street, are primarily interested. J. Sitzenstatter, the company's engineer, is now on his way from England, where he recently went to purchase material, etc. The Samuel firm represent the interests of the British concern, W. T. Henley's Telegraph Works Company. The major portion of the material will be furnished by that company. The automatic signaling switchboard, etc., will very likely be purchased in the States.

S. K. C. Induction Motors.

The induction motor by reason of its simplicity of construction and operation and its high efficiency, is becoming more and more popular, not only as an adjunct in great transmission systems where alternating currents are necessarily employed, but also for local distribution of power in factories, mines and other industrial establishments, where in many instances it has been given the preference over the direct-current motor. To meet the wide range of conditions which induction motors encounter in actual service, the Stanley Electric Manufacturing Company, of Pittsfield, Mass., manufacture three distinct types, which are separately treated below.

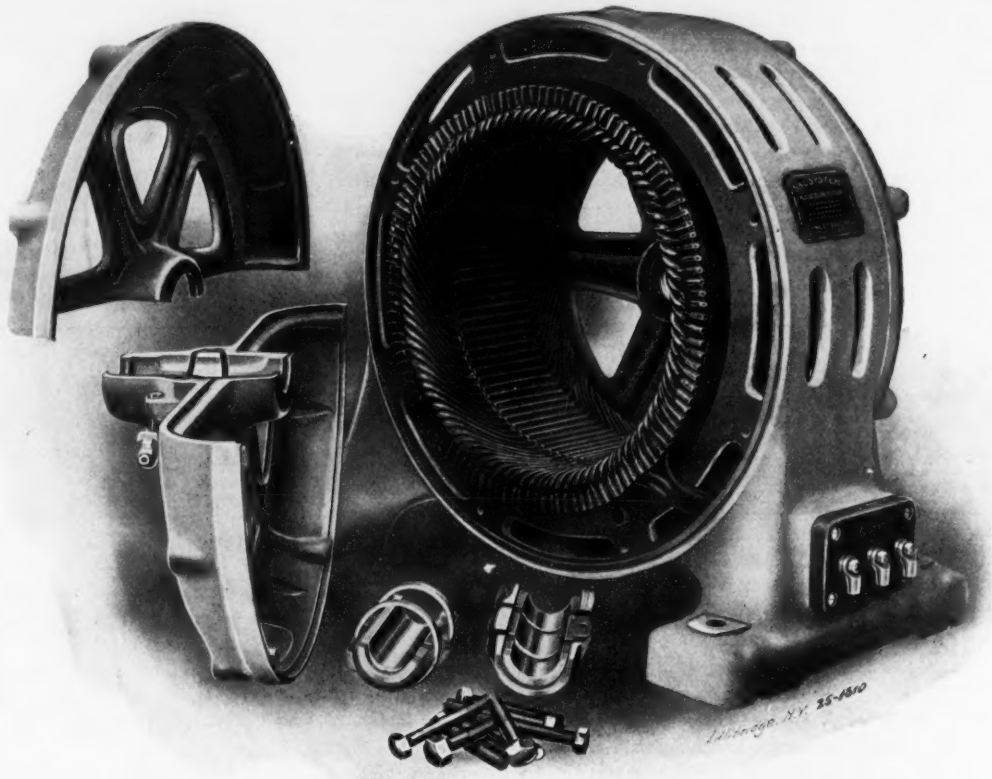


FIG. 1.—INDUCTION MOTOR WITH ARMATURE OR SECONDARY REMOVED, SHOWING PRIMARY WINDING AND BEARINGS.

The motor shown in Fig. 1 is the simplest type. The armature or secondary is of the "squirrel-cage" type, and consists of straight copper bars laid in partly closed slots, with practically no insulation, and short-circuited by means of heavy end rings, as shown in Fig. 2. Injury to the armature either by heating or by mechanical displacement of the parts is practically impossible, and the wear on the motor is reduced to that which takes place in the bearings. Owing to the extreme simplicity of armature construction, this type is the most desirable where the conditions admit of its use; namely, where

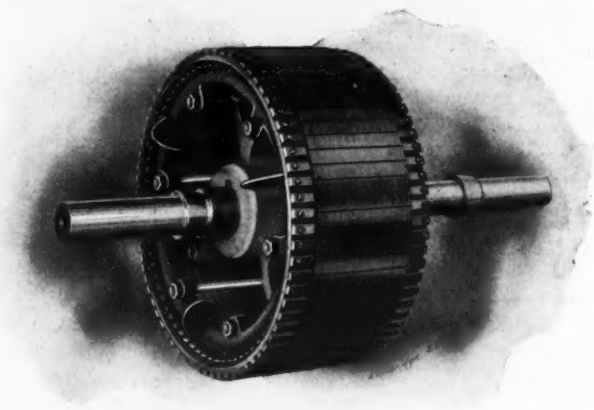


FIG. 2.—ARMATURE OF "TYPE A" MOTOR.

the motor is not required to start heavy loads, or where a large starting current will not injuriously affect the potential regulation of the system. It is possible to start the motor by simply closing the line switch, and this method is used with motors below 5 hp. But as the first rush of current, when so starting, amounts to several times the running current, it is advisable to use with the larger sizes of motors a device called a starting compensator to reduce the voltage impressed upon the motor, and thus decrease the current taken.

The starting compensator consists of a single coil transformer in each phase of the circuit, with taps brought out at various points of the winding in order that a number of potentials may be obtained. The compensator is provided with a double-throw oil switch, by

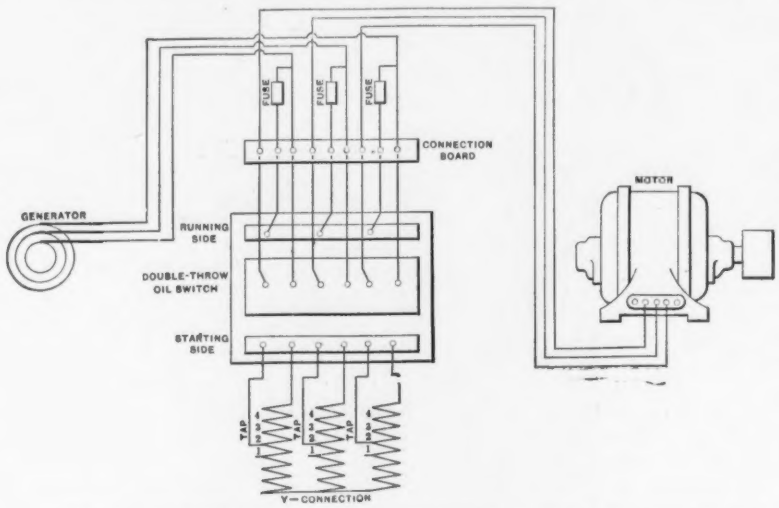


FIG. 3.—STARTING COMPENSATOR CONNECTED TO THE LINE AND TO THE MOTOR.

means of which, after starting, the coils are cut out and the full voltage of the line applied to the motor. Fig. 3 shows diagrammatically the construction of the compensator and the method of connecting it to the line and to the motor.

The point at which the compensator should be connected will depend upon the torque which the motor must develop on starting. The compensators are normally connected to the first tap in the winding, so as to give the minimum voltage and therefore the lowest current. Should the torque thus developed be unequal to that necessary, a proper adjustment of the connections of the compensator to

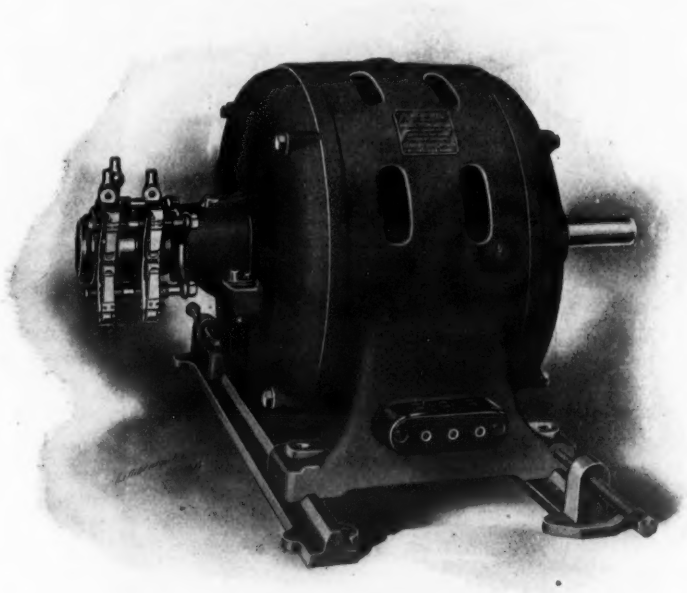


FIG. 4.—VARIABLE-SPEED INDUCTION MOTOR.

secure a higher potential can readily be made. In the second type of motor the starting current is kept low by introducing starting resistance within the secondary circuit. This type does not possess the same simplicity of construction as the type just described, owing to the fact that the armature has a polar winding and a device for varying the armature resistance is necessary, but it has this advantage—it will start a given load with a current materially less than that taken by the other motor. Therefore, it is recommended where the motor must start heavily loaded and where a large current, such as the motor with short-circuited armature takes when starting at full load, would be objectionable.

The starting resistance is placed within the armature spider, and leads are brought out from several points of the resistance to a set of contacts parallel to the shaft. A lever on the outside of the motor operates a sliding collar, which is arranged to pass over the contacts, so that the resistance, on starting the motor, can be short-circuited step by step.

In the third type of motor a variation in speed is secured by varying the resistance within the secondary or armature circuits. This resistance is located external to the armature so that the heat is generated at a distance from the motor and the resistance may be left continually in circuit if desired. The armature winding is similar to that of the motor just described. The leads from the winding are carried through a hollow shaft to the collector rings by means of which connection is made with a suitable controller for cutting in and out the external resistance. As is obvious, the controller constitutes a most satisfactory device for starting the motor.

The motors can develop a torque of at least 200 per cent. of their normal full load. Therefore, they are not liable to injury by temporary heavy overloads. The temperature rise of a motor of either of the three types on a continuous run at full load will not exceed 40° C. The speed of the two first mentioned types varies but slightly from no load to full load, the variation not exceeding 2 per cent. in the larger motors, and 5 or 6 per cent. in the smaller sizes.

Mexican Power Transmission Systems.

A syndicate composed of President Coffin, of the General Electric Company; President Hine, formerly of the Stanley interests, now head of the Guanajuato Light & Power Company, Limited; John Hays Hammond, the mining expert; the Bonbrights, of Denver, Colo.—in short the same group of Americans that is interested in the Guanajuato Light & Power Company, Limited, is to construct another important power transmission system in the Southern Republic.

An hydraulic plant capable of developing 10,000 hp, is to be built on the Rio de Valle for the purpose of generating energy for transmission to the El Oro mining district, one of the most important mineral regions in Mexico. The current will be conveyed about 45 miles. The volume of water available is 6,000 cu. m per second. The working head will be 269 m. Construction work is expected to begin in the early fall.

The Guanajuato Light & Power Company's plant at Zamora, on the Duero River, is rapidly nearing completion. It is anticipated that power will be conveyed to the Guanajuato mining district, 103 miles distant, by October 1. The plant is to be operated at the outset at 60,000 volts. The initial equipment will have a capacity of 4,000 hp. There will be two 1,500-kw General Electric generators, each direct-connected to two 1,000-hp Pelton wheels. The contract for the piping is being executed by Joseph T. Ryerson & Son, of Chicago, New York offices, 17 State Street. One of the several features of the system will be the use of galvanized steel towers for the transmission line. Twelve of these poles will be placed to each mile. The Aermotor Company, of Chicago, was awarded the contract.

Tobacco Factory Equipment.

The Blackwell's Durham Tobacco Company has recently placed an order with the Westinghouse Electric & Manufaturing Company for an alternating-current generator, 75-kw capacity, 250 volts, 25 cycles, 500 r.p.m., this being the third generator ordered by this well-known tobacco company for its factory at Durham, N. C. About two years ago the initial installation was made of a 150-kw, 25-cycle, 200-volt, belted type alternator, together with exciter and switchboard, and also about 150 hp in induction motors ranging in capacity from 3 to 20 hp. These motors are used to drive the various machinery used in the manufacture of this brand of smoking tobacco,

such as re-ordering machines, granulating machines and automatic picking machines, also elevator and other incidental machinery.

The original electrical installation proved so successful that last year the tobacco company decided to install an additional generator and ordered a Westinghouse 75-kw, 2-phase, 220-volt, 3,000 alternation, belted generator, complete with switchboard. This was arranged to run in parallel with the previous generator,

The factory has now been further enlarged and it was found necessary to increase the output of the combined plant which led to the placing of this recent order for 75-kw generator and new switchboard arranged for the control of all three generators, and also the necessary feeders.

The Martin Rocking Grate.

Many rocking grates have so many objections in the way of heavy depreciation by melting and warping of the bars, that there are a number of engineers who will have nothing to do with them. Some grates are so irregular that they do not permit a hoe or slice bar to be run over them, while others have fingers which interlock or engage with each other, and these fingers become burned off.

The Martin grate is evidently one upon which much thought and ingenuity has been expended in the design to overcome these objections. Fig. 1 shows one of these grate bars out of the furnace. Fig. 2 shows an assembled furnace with grate bars. They extend lengthwise of the furnace. The heavy part of the bar is so far

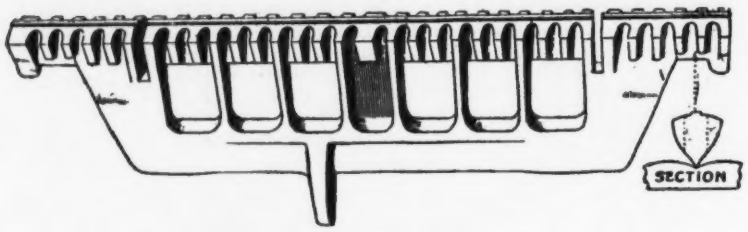


FIG. 1.—VIEW OF A GRATE BAR.

below the fire that it does not become hot enough to warp. The principal part of the bar upon which the fire rests is provided with slots that allow of its expansion and contraction. The bar is only 1½ in. wide, including the teeth, and is about 5½ in. deep. All the bars rock in the same direction at the same time, and the space between the bars is not enlarged by the rocking. The clinkers, therefore, cannot clog the grate by dropping between the bars during shaking. The grate is heavy, weighing about 80 pounds to the square foot. The design, together with the weight, make it a very durable form. The grate bars rest like an inverted cone on the bearing bars, so that they rock very easily.

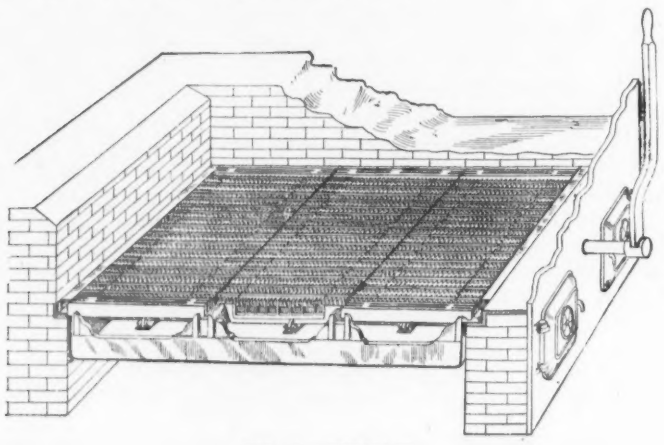


FIG. 2.—FURNACE.

The grate has been in use for a number of years in many well-known steam plants. Thomas W. Smith, chief engineer Crane Company, Chicago, says that "after four years' service these grates are in as good condition as when first put in." They are under twenty-two boilers at the Joliet mills of the American Steel & Wire Company. The Otis Elevator Company, the Citizens' Electric Light Company, of Altoona, Pa., and the Oshkosh Electric Light Company, of Oshkosh, Wis., are among a long list of users of this grate, only a few of whom have been mentioned here. The grate is made by the Martin Grate Company, 83 Van Buren Street, Chicago. It is fitted to burn any kind of coal, but is especially adapted for soft coal, slack and screenings, or in other words for cheap coals.

Battery Fan Motor.

In the season of hot waves, the fan motor is truly regarded as one of the necessities to human comfort, and where there is any system of electrical supply, its use is becoming universal. Taking the country as a whole, however, the offices and residences not having the benefit of electrical service are largely in the majority, and to these the battery fan motor offers itself as a substitute. One of the recent types of a battery fan outfit is shown in the accompanying illustra-

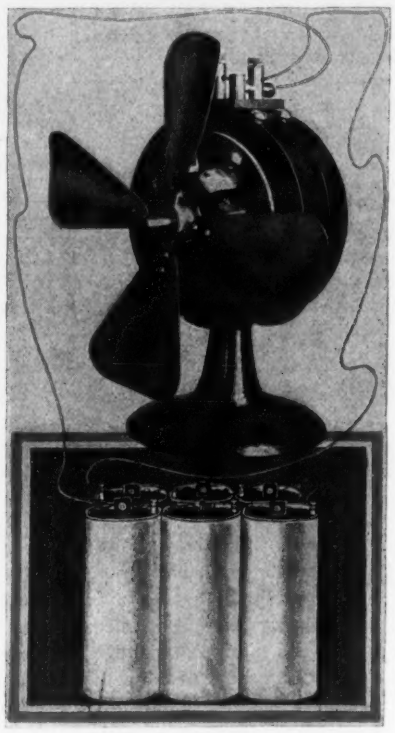
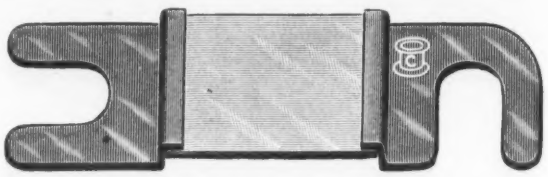


FIG. 3.—BATTERY FAN MOTOR.

tions, the source of current being a dry-battery. The manufacturers, Ewing-Merkle Electric Company, 1106 Pine Street, St. Louis, state that a 7¼-inch fan can be run with six cells of dry battery for 200 hours without renewal, thus bringing the cost to less than one cent per hour.

New Link Terminal.

The accompanying illustration shows an improved form of terminals for copper-tipped fuse links, upon which a patent has recently been granted to the Chicago Fuse & Wire Co., Chicago, New York and Buffalo. The fuse shown is especially adapted for use in main cut-outs and for dynamo fuses. The special advantage claimed for



FUSE LINK AND TERMINAL.

these links is that a strong and reliable connection is secured between the fuse and terminal, there being, it is asserted, contact surface twice as great as that of the ordinary style of construction. The completed fuse is also very compact. The company has for some time been using this style of connection with the larger size of fuses, which are made from strip with satisfactory results.

NEWS OF THE WEEK.

Financial Intelligence.

THE WEEK IN WALL STREET.—Money closed at 3½@4 per cent. for 60-day loans. The stock market, although dull, was weak in tone, the principal unsettling factors being a decline in New York Central and the weakness in United States Steel shares. Favorable crop advices failed to stimulate any activity in Western railway stocks, although earnings continue to show large increases. The money market continued easy, although the shipment of over $6,000,000 of gold to Europe was among the unfavorable symptoms of the week. At the close of the week New York Central declined, with several other stocks, to the lowest point of the year. In the case of the United States Steel securities, the decline was based upon unfavorable reports about the character of the showing for the June quarter and the half-year ending June 30, while it was also suggested that there was some question about the declaration of the regular quarterly dividend on the common stock. This last report, however, proved altogether unfounded, since the directors have since declared the regular dividend. All of the traction and electric securities participated in the general downward movement and suffered losses. Brooklyn Rapid Transit lost 3⅛, closing at 55¼, after having reached 54¾. Metropolitan Street Railway closed at 120¼, being a loss of 2¾ points. This stock reached the lowest point of the year, viz., 119¾. General Electric closed at 173, which was the lowest point of the week, and a net loss of 4 points. Western Union closed at 83⅝—a loss of 1¾ points. American Telephone & Telegraph closed at 132, being a loss of 4 points. Following are the closing quotations of July 14.

NEW YORK.

	July 7.	July 14		July 7.	July 14
American Tel. & Cable	80	77	General Electric	..	170¼
American Tel. & Tel	131	127	Hudson River Tel	..	..
American Dist. Tel	30	26	Metropolitan St. Ry	122¾	118¾
Brooklyn Rapid Transit	57⅝	52	N. E. Elec. Veh. Trns	..	..
Commercial Cable	..	..	N. Y. & N. J. Tel	..	..
Electric Boat	17	15	N. Y. E. V. T. Co	5½	5
Electric Boat pfd	40	35	Tel. & Tel. Co. Am	..	..
Electric Lead Reduction	1	1	Western Union Tel	..	83
Electric Vehicle	7¼	7	Westinghouse com	..	..
Electric Vehicle pfd	13½	13	Westinghouse pfd	..	..

BOSTON.

	July 7.	July 14		July 7.	July 14
American Tel. & Tel	152	128⅛	Western Tel. & Tel. pfd	90*	90*
Cumberland Telephone	..	..	Mexican Telephone	1⅝	1⅝
Edison Elec. Illum	..	242	New England Telephone	129	128¾*
General Electric	..	173	Westinghouse	..	..
Western Tel. & Tel	13	13	Westinghouse pfd	..	..

PHILADELPHIA.

	July 7.	July 14		July 7.	July 14
American Railways	..	..	Phila. Traction	95¾	95¾
Elec. Storage Battery	60	60	Phila. Electric	6⅛	5⅞
Elec. Storage Battery pfd	..	..	Pa. Electric Vehicle	..	..
Elec. Co. of America	8⅞	8¾	Pa. Electric Vehicle pfd	..	..

CHICAGO.

	July 7.	July 14		July 7.	July 14
Central Union Tel	..	..	National Carbon pfd	93	92
Chicago Edison	..	147	Northwest Elev. com	..	..
Chicago City Ry	190	185	Union Traction	4	4
Chicago Tel. Co	..	..	Union Traction pfd	30	30
National Carbon	23	23¼			

*Asked.

AMERICAN TELEPHONE & TELEGRAPH.—An additional $5,018,700 of the capital stock of the American Telephone & Telegraph Company has been listed on the New York Stock Exchange, making the total amount listed to date $109,700,100. This stock is, according to a statement made to the Stock Exchange, part of the capital stock for which admission to the list was requested in the company's application of June 18, 1901, of which 620,944 shares ($62,094,400) were admitted in September, 1901, and 321,431 shares were then withheld from the list. Of this amount (321,431 shares) 5 shares were then withheld from the list by reason of a clerical error in a letter of July 11, 1901, from the treasurer of the company to the secretary of the New York Stock Exchange, and 321,426 shares ($32,142,600) were then withheld because they were held by the American Bell Telephone Company, as set forth in the letter above named. Of the 321,426 shares ($32,142,600) above mentioned, then held by the American Bell Telephone Company, 50,182 shares ($5,018,200) have been released from the stipulations of any agreement and from any obligations arising therefrom, as also appears from the statement by the secretary of the American Bell Telephone Company. Since the date, January 8, 1903, of the previous application made by this company for the admission to the list of any of its capital stock the stockholders at a special meeting duly called and held on March 31, 1903, increased the capital stock from $150,000,000 to $250,000,000. The company is presently to receive subscriptions for a part of this additional stock, for the admission of which application is to be made hereafter with statement of the purposes to which the proceeds are to be applied when the amount of such subscription has been determined. The amount now issued is $136,826,600 (1,368,266 shares) of which $104,681,400 (1,046,814 shares) is now listed upon the exchange; $2,100 (21 shares) are presently to be notified as paid for; $5,018,700 (50,187 shares) are the subject of this application, and the remainder $27,124,400 (271,244 shares), are held by the American Bell Telephone Company.

ST. LOUIS POWER CONTRACT.—One of the largest contracts of its kind ever executed has just been closed between the St. Louis Transit Company and the Union Electric Light & Power Company for electric power. The contract in effect is a 10-year agreement with the traction syndicate, providing for the use of approximately 12,000 hp per diem. Delivery of this enormous current will commence on May 1, 1904, the contract having been made with an especial view to use at the beginning and during the World's Fair. Charles W. Wetmore, vice-president of the Union Electric Light & Power Company, estimates that the receipts under the deal with the Transit Company will amount to at least $600,000 per annum, or $6,000,000 for the ten-year period. The closing of this contract indicates the abandonment of the rather elaborate plans whereby the St. Louis Transit Company was to establish a power house on the East Side, presumably on the river front, for the generation of power, carrying the power under the Misissippi River by means of cables. It was even stated at one time that options had been secured on property in East St. Louis and that a site for a central transforming and distributing station had been selected in East St. Louis. Officials of the Union Electric Light & Power Company state that the power sold to the Transit Company, will be sent from the new central power station, being built at Levee and Ashby Streets, construction of which will be completed on April 1, 1904.

UNITED STATES STEEL.—At the monthly meeting of the directors of the United States Steel Corporation, held last week, the regular dividends were declared on both the preferred and common stocks, and a statement of its earnings, including those for the quarter ending June 30, 1903, was made. The net earnings for the quarter were $36,499,828, which is a decrease of 3 per cent. from the corresponding quarter of 1902, but an increase of 32 per cent. compared with the preceding quarter, ending March 30. The following table is a comparison of the first half of 1902 with the first half of the current year:

	1903.	1902.
Net earnings	$61,568,235	$64,407,153
Sinking fund	729,795	240,428
Balance	$60,838,440	$64,166,725
Depreciation and reserve fund	6,655,504	6,556,028
Balance	$54,182,936	$57,610,697
Interest and sinking fund U. S. Steel bonds	9,120,000	9,120,000
Balance	$45,062,936	$48,490,697
Dividends	28,025,889	28,027,074
Surplus	$17,037,047	$20,463,623

AMERICAN DISTRICT TELEGRAPH EXPANDING.—The American District Telegraph Company of New Jersey has been engaged for several months in acquiring the stocks of district messenger companies throughout the United States. Some forty different companies in the larger cities, including Baltimore, Cleveland, Philadelphia, Chicago and Buffalo, have been secured by the New Jersey company and are now being operated by it. Three companies are still outside the combination. The latest offer of the American District of New Jersey was made last week for the Mutual District Messenger Company, of Boston, whose stockholders were notified that the New Jersey company had made a proposition to purchase its stock. The offer was on the basis of eight-tenths of a share of the New Jersey company stock for each share of the Mutual District Company's stock. The capital of the Boston company is $225,000. It is stated that the plan of the New Jersey company is to amalgamate and bring into close relations with it the messenger service of every city in the United States which is in any way identified with or dependent on the service of the Western Union Telegraph Company. The American District Telegraph Company of New Jersey is known as a Gould company, the Gould interests predominating in its directorate. It is capitalized at $10,000,000.

CLEVELAND ELECTRIC RAILWAY.—The consolidation of the two local street railway systems in Cleveland having been effected will control 200 miles of lines. Patrons will be given six tickets for a quarter. This was decided at a meeting of the directorate in Senator Hanna's office last week. The Cleveland Electric Railway Company has requested authority of the State to increase its capital from $13,000,000 to $23,400,000 to provide for the purchase of the Cleveland City Railway Company. The directors elected the following officers: President, Horace E. Andrews; vice-president, Christopher F. Emery; treasurer, George Russell; assistant treasurer, John Ehrhart; secretary, H. J. Davies; general manager, John J. Stanley; general superintendent, George G. Mulhern. Senator Hanna is chairman of the board of directors.

MEXICAN TELEGRAPH COMPANY shows results as follows:

March 31st, surplus after payment of April dividend	$1,242,164
June 30th quarter (partly estimated) gross	$117,500
Expenses (partly estimated)	22,500
Net	$95,000
Interest	13,371
Balance	$108,371
Mexican government's proportion	5,000
Balance	$103,371
Dividend	47,815
Surplus	$55,556
Total surplus	1,297,720

CENTRAL & S. A. TEL. COMPANY reports as follows:

March 31 surplus after payment of April dividend	$726,719
June 30 quarter (estimated) gross	$250,000
Expenses	103,000
Net	$147,000
Interest	5,000
Balance	$152,000
Dividend	115,884
Surplus	$36,116
Total estimated surplus	762,835

STOREY MOTOR COMPANY RECEIVERSHIP.—George R. Beach, of Jersey City, was appointed receiver for the Storey Motor & Electric Company, of Harrison and New York, by Vice Chancellor Stevens on July 7. The company was incorporated in October, 1901, with a capital of $500,000. The application was made by Frank T. McDermott, of Jersey City, and Frederick Weimer, of New York, counsel representing Henry E. Fanshawe, vice-president and general manager of the concern. The holders of a $40,000 mortgage and more than 75 per cent. of the bondholders concurred in the request for the appointment of a receiver, which, it is stated, is desired to prevent legal interruption to the reorganization plan. The concern's total nominal assets are stated to be $90,000 and total liabilities $70,000, including $34,000 due the bondholders.

MORTGAGE IN ST. LOUIS.—Four millions of first mortgage 5 per cent. thirty-year gold bonds are to be issued by the Union Electric Light & Power Company, St. Louis, Mo., through the Mississippi Valley Trust Company, N. W. Harris & Co. and Altheimer & Rawlings Investment Company. The present issue will be $2,000,000 and during the year a like amount will be issued. The proceeds will be used in part for the purpose of retiring existing liens, amounting to $1,552,000, on the properties of the Union Company; also for the purpose of greatly increasing its plant. The company has a ten-year contract to furnish power to the St. Louis Transit Company, as noted elsewhere.

ELECTRIC COMPANY OF AMERICA.—At the meeting of the board of directors of the Electric Company of America, in Philadelphia last week, the president reported that the full returns for five months show that in the net earnings there was a gain of over 19 per cent. over the same period of the previous year. The board passed a resolution unanimously advising that the par value of the stock be increased from $10 to $50 a share. A special meeting to vote on this question will be held in the Fall.

AMERICAN TELEGRAPH ELECTION.—At the annual meeting of the American Union Telegraph Company of New Jersey, in Jersey City last week, these directors were elected: A. R. Brewer, J. B. Bertholf, B. Brooks, R. C. Clowry and T. F. Clarke. The directors subsequently elected these officers: R. C. Clowry president, Thomas F. Clarke vice-president, and A. R. Brewer secretary and treasurer.

Commercial Intelligence.

THE WEEK IN TRADE.—The trade conditions in general are very much improved. The winter wheat crop harvest has about been completed with a considerably larger yield than last year; retail trade in summer goods has improved, and re-orders from jobbers are larger in volume. Confidence in a large fall trade grows as corn and cotton make up for their early backward start; clearings are in excess of a year ago at most centers; railroad earnings continue to show gains over all preceding years, and prices develop exceptional steadiness for a mid-summer period. Although money still remains easy, reports from Western centers indicate that the country has already begun to draw supplies for crop-moving purposes. The labor situation shows some improvement. On the Pacific coast the lumber trade is especially active at Portland, Ore. Business at the East is rather better as a whole, due partly to the improved outlook in labor matters. The iron and steel market is dull and unsettled as to prices. Inquiries are numerous, but new business in iron is scant. A good volume of orders for rails has been booked. The copper market was weak and low, and the official prices have been reduced to 14c. for Lake and electrolytic and 13½c. to 13¾c. for casting stock. It is reported, however, that Lake is obtainable at 13¾c.; electrolytic at 13½c. and casting at 13¼c. The demand is very small and there is less confidence than ever. The business failures for the week ending July 9, as reported by *Bradstreet's*, numbered 154, against 162 the week previous, and 195 the corresponding week last year.

EXHIBITORS AT THE STREET RAILWAY CONVENTION.—Following is a list of concerns which have taken space for exhibits at the convention of the American Street Railway Association, at Saratoga, September 2, 3 and 4 next: Adams & Westlake Company, Chicago; American Automatic Switch Company, New York; American Brake-Shoe & Foundry Company, New York; American Car Seat Company, Brooklyn; American Railway Supply Company, New York; American Steel & Wire Company, Chicago; Atlas Railway Supply Company, Chicago; Baldwin Locomotive Works, Philadelphia; Bemis Car Truck Company, New York; Berry Brothers, Detroit; E. W. Bliss Company, Brooklyn; J. G. Brill Company, Philadelphia; Harold P. Brown, New York; Bruck Solidified Oil Company, Boston; Brady Brass Company, New York; L. C. Chase & Co., Boston; Christensen Engineering Company, New York; Adam Cook's Sons, New York; R. W. Conant, Cambridge; Consolidated Car Fender Company, New York; Consolidated Car Heating Company, Albany; Continuous Rail-Joint Company, Chicago; Curtain Supply Company, Chicago; Dearborn Drug & Chemical Works, Chicago; Detroit Trolley & Manufacturing Company, Detroit; Duff Manufacturing Company, Allegheny; Electric Storage Battery Company Philadelphia; ELECTRICAL WORLD AND ENGINEER, New York; Electric Railway Equipment Company, Cincinnati; C. J. Field, New York; General Electric Company, Schenectady; Globe Ticket Company, Philadelphia; Gold Car Heating & Lighting Company, New York; Hale & Kilburn Manufacturing Company, Philadelphia; C. J. Harrington, New York; Heywood Bros. & Wakefield Company, Philadelphia; Howe Manufacturing Company, Scranton; International Register Company, Chicago; H. W. Johns Manville Company, New York; Kinnear Manufacturing Company, Columbus; C. S. Knowles, Boston; Le Valley Vitæ Carbon Brush Company, New York; Lorain Steel Company, Lorain; Ludlow Supply Company, Cleveland; Lumen Bearing Company, Buffalo; G. P. Magann Air-Brake Company, Detroit; National Carbon Company, Cleveland; National Electric Company, Milwaukee; National Ticket Company, Cleveland; National Lock Washer Company, Newark; F. H. Newcomb, Brooklyn; R. D. Nuttall Company, Pittsburg; Ohio Brass Company, Mansfield; Ohmer Fare Register Company, Dayton; Pantasote Company, New York; Peckham Manufacturing Company, New York; Pennsylvania Steel Company, Philadelphia; T. Raymond Pierce, Boston; Pittsburg Reduction Company, Chicago; Pittsburg Switch & Signal Company, Pittsburg; Railway Appliance Company, Albany; Railway Appliances Company, Chicago; Root Track Scraper Company, Kalamazoo; Rossiter, MacGovern & Co., New York; Railway Sander Company, Toronto, Canada; Sherwin-Williams Company, Cleveland; Standard Paint Company, New York; Standard Vitrified Conduit Company, New York; Star Brass Works, Kalamazoo; John Stephenson Company, Elizabeth; Sterling-Meaker Company, Newark; Sterling Varnish Company, Pittsburg; St. Louis Car Company, St. Louis; Stuart-Howland Company, Boston; *Street Railway Journal*, New York; *Street Railway Review*, Chicago; Taylor Electric Truck Company, Troy; Traction Equipment Company, Brooklyn; Uni Signal Company, Cambridge; United States Curtain Company, Newark; Van Dorn & Dutton Company, Cleveland; W. T. Van Dorn Company, Chicago; Wm. T. Watson, Newark; Weber Railway Joint Manufacturing Company, New York; *Western Elec-*

trician, Chicago; Westinghouse Electric & Manufacturing Company, Pittsburg; Wm. Wharton, Jr., Company, Philadelphia; Wheel Truing Brake-Shoe Company, Detroit. Exhibits may be placed four days before the opening of the convention. The exhibition will open September 1.

NERNST LAMPS.—The Pennsylvania Railroad Company is equipping more of its offices with Nernst lamps. The Philadelphia office of the Nernst Lamp Company reports that twenty-six six-glower and five three-glower Nernst lamps have recently been installed in the freight department of the Pennsylvania Railroad, at Broad and Washington Avenues, Philadelphia, this being one of the most important departments of the company. Several three-glower Nernst lamps have also been placed in the power house at Camden, N. J., and the lighting equipment at the new passenger station is about to be completed by the installation of twenty-three lamps of the three-glower type, which will be an addition to the six-glower Nernst lamps already in use. It is expected that the new shops of the Philadelphia, Baltimore & Washington branch of the Pennsylvania Railroad will be largely lighted by these lamps, the six-glower type being used.

THE GENERAL INCANDESCENT COMPANY ABSORBED BY GENERAL ELECTRIC.—A dispatch from Syracuse, N. Y., dated July 8, states that word has been received there that the General Incandescent Arc Light Company, which was to have moved to that city, has been absorbed by the General Electric Company and will go to Pittsfield, Mass., instead. The Chamber of Commerce of Syracuse had raised several thousand dollars to defray the moving expenses of the concern and the company had leased the Barnes, Cobb & Phoenix foundry buildings in that city. The *Wall Street Journal* states that an official of the General Electric Company confirms the report that his company is negotiating for the purchase of the General Incandescent Company, and that the plant will be moved to Pittsfield.

BROOKLYN RAPID TRANSIT IMPROVEMENTS.—The Brooklyn Rapid Transit Company intends to make extensive improvements during the present year and $14,008,719.73 has been appropriated for this purpose. Of this amount $6,000,000 is to be used for a new power house on Kent Avenue with a capacity of 80,000 hp; $3,124,962 is to be expended in the enlargement of other power houses; $1,821,500 for the improvement and equipment of the elevated and surface lines; $1,295,935 for miscellaneous work, including new tracks and new buildings; $1,153,823 for the construction of underground conduits for carrying feeder cables, and $612,500 for the purchase of real estate.

COPPER PRICES.—A large producer of Lake copper says that when the metal was reported to be selling at 15¼ cents per pound he was unable to make sales at 15 cents. He now declares that although the nominal price is 13⅞ to 14 cents, he can find no buyers who are willing to pay over 13⅝ cents. The manipulation of the United Metals Selling Co., he says, is hurting the market, because no one knows what a fair price is. Consumers were bearish when the market was advancing a few months ago, and now they are bullish when the market is steadily declining. Prices of finished goods are now considerably higher than they should be, with copper selling at 13⅞ cents.

THE EUREKA ELECTRIC COMPANY, of Genoa and Chicago, has recently supplied the Hoosier Telephone Company, of Salem, Ind., with a 300-line switchboard of its new bell style ring-down type. This company is making a specialty of this style of board, and anticipates a very large sale of it. It is very simple in construction and operation and combines many desirable features. The company has completed its new factory at Genoa, Ill., which gives it three times its former capacity. From the present outlook the company thinks that it will be necessary to enlarge the factory before another year elapses.

WESTINGHOUSE CANADIAN COMPANY.—The Canadian Westinghouse Company has been incorporated with headquarters at Hamilton, Ont. The names of the incorporators, as given in a dispatch from Ottawa, are as follows: George Westinghouse, Pittsburg; Henry Herman Westinghouse, New York; George Carson Smith, Pittsburg; Frank Hendrickson Taylor, Pittsburg; Loyall Allen Osborne, Pittsburg; Thomas Ahearn and Warren Young Soper, Ottawa; Paul Judson Myler, Hamilton.

TULA IRON WORKS, MEXICO.—A company styled the Tula Iron Company has been incorporated under the laws of New Jersey with a capital of $2,500,000 common stock and $7,500,000 of preferred stock to acquire the Tula Iron Works, near Guadalajara, Mexico. Mr. Ralph H. Beach, of the General Electric Company, is the principal party interested in the enterprise. Later on it is proposed to utilize water power of which there is abundance in the vicinity for the purpose of operating the works.

ILLINOIS TELEPHONE & TELEGRAPH COMPANY.—The Illinois Telephone & Telegraph Company has won its fight in the city council and secures practically all it asked for, says a Chicago dispatch. It secured a franchise for 26 years for its tunnels and the privilege of transporting "mail, newspapers, packages and merchandise" upon the payment to the city of a proportion of the gross receipts from all revenue and the turning over to the city of its tunnels at the expiration of the franchise.

CHICAGO TELEPHONE.—A Chicago dispatch says: "A fight has been begun in Chicago City Councils against an application by the United Telegraph, Telephone & Electric Company for a city telephone franchise authorizing a measured service, on the ground that the Chicago Telephone Company, which is a subsidiary concern to the American Telephone & Telegraph Company, is the real applicant seeking thus to obtain a satisfactory substitute for its present franchise which expires in 1909."

LIGHTING EQUIPMENT FOR JAPANESE WARSHIP.—The British electrical engineering and contracting firm of L. J. Healing & Co., Yokohama, whose New York representative is Francis A. Cundill, 90-96 Wall Street, has secured an order for a marine generating set for installation for lighting purposes in a Japanese warship. The equipment will consist of a multiple 25-kw, 450 r.p.m. General Electric generator, direct-connected to a tandem-compound engine.

TUERK FANS FOR THE FAR EAST.—E. B. Latham & Co., 39 Vesey Street, New York, report a substantial foreign demand for Tuerk alternating-current ceiling fans, the orders on hand showing an increase of more than 50 per cent. above those on the books up to a similar period last year. The foreign contracts at present come chiefly from the Far East. Good-sized orders have just been booked for shipment to both Shanghai and Manila.

SWITCHBOARD CONTRACTS.—The Stromberg-Carlson Telephone Manufacturing Company, of Chicago and Rochester, has recently closed contracts for switchboards for the following companies: Adena Telephone Company, Adena, Ohio; Vigilant Telephone Company, Dillonville, Ohio; Morrow County Telephone Company, Mt. Gilead, Ohio; also a large number of telephones to the last-named company.

THE SOUTH SIDE ELEVATED RAILROAD COMPANY, of Chicago, has recently purchased a Westinghouse 1,500-kw railway type generator of 600 volts, and running at 75 r.p.m., which is to be installed in its power house at the corner of Fortieth and State Streets. This power house already contains two Westinghouse generators of the same type and size, which have been in successful operation for some time.

OSAKA EXHIBITS.—A consular report from Kobe, Japan, says that in one of the departments of the Osaka Exposition a very creditable exhibit is made of American machinery. Among the American firms represented are the Niles-Bement-Pond Company, the Pratt & Whitney Company, the Rand Drill Company, Buffalo Forge Company, the Laidlaw & Fay-Egan Companies, Brown & Sharpe and L. S. Starret.

THE SWEDISH-AMERICAN TELEPHONE COMPANY has recently furnished complete exchange equipment for the following named independent telephone organizations: The New Telephone Company, New, Ohio; the Potosi Telephone Company, Potosi, Mo.; the Palo Telephone Company, Palo, Mich.; the Idaville Mutual Telephone Company, Idaville, Ind., and the Illiopolis Telephone Company, Illiopolis, Ill.

ELECTRIC COAL-CUTTING PLANTS FOR JAPAN.—Francis A. Cundill, 90-96 Wall Street, New York representative of the British electrical engineering and contracting firm of L. J. Healing & Co., Yokohama, is about to let contracts for electric coal-cutting plants for installation in two of the large Japanese collieries. The electrical equipment for the larger plant will be of 75-kw capacity.

JUNE BUSINESS FAILURES.—According to *Dun's,* the manufacturing concerns which failed during June showed liabilities amounting to $2,642,516, against $3,261,365 in June, 1902. The liabilities of trading companies that failed amounted to $3,443,456, against $5,728,300 for June, 1902. The liabilities of brokers and transporters was $2,240,682, against $1,184,252 in June, 1902.

COPPER.—Negotiations for the sale of 40,000,000 pounds of Lake copper at 13⅜ cents, it is stated, are pending. The prospective buyer is a large brass concern. Lake copper is now offered at 13¾ cents, but it is believed that a bid of 13½ cents would be immediately filled.

THE BARRIETT ELECTRIC COMPANY is the name of the reorganized Cincinnati Electric Motor Company. Mr. S. L. Barriett is president of the company. It will continue business in Cincinnati in the same establishment as before. The capital stock has been doubled.

GENERAL ELECTRIC BUYS A LYNN WHARF.—The General Electric Company has purchased the wharf property on Western Avenue at Fox Hill Bridge, Lynn, Mass., from the estate of William M. Newhall.

General News.

THE TELEPHONE.

CONGRESS, ARIZ.—The Arizona State Telephone Company connects with the Prescott Company's lines. It has a 50-drop board; 140 subscribers and 70 miles of toll line. A line into Phœnix is to be built.

OZARK, ARK.—The Home Telephone Company rents its switchboard and telephones from the Southwestern Telephone & Telegraph Company and connects with the latter's long distance lines. A 100-drop board, 100 subscribers and 60 miles of toll line are supplied by the Home company.

NEWMAN, ILL.—The Chapman Telephone Company has a 100-drop board, 135 subscribers and 20 miles of toll line.

FARINA, ILL.—The Farina & Vandalia Telephone Company has eight stations, 39 miles of toll line and the same length of rural line.

HOOPESTON, ILL.—The Hoopeston Telephone Company operates a 300-drop board with 450 subscribers and 50 miles of toll line.

JERSEYVILLE, ILL.—The Illinois Telephone Company is building a line from Carrollton to Kane, north of Jerseyville and will establish an exchange at Kane.

MONMOUTH, ILL.—The Monmouth Telephone Company has a 550-drop board, 630 city and 260 country subscribers. The rates are $1 and $2 for residences and business houses.

OLNEY, ILL.—The Richland County Telephone Company has all it can do to meet demands for service. A 400-drop board supplies 350 subscribers, and there are 250 miles of toll line. Business rates are $2 and $2.50; residences $1 and $1.50.

ALTON, ILL.—The demand for telephone connection was great in Alton during the recent flood. Men who desired to get word to their families offered as much as $5 and $10 for the privilege of immediate connection. The operators simply said: "Await your turn and you'll only pay 25 cents." Only one wire, that of the Central Union, was working to St. Louis during most of the time of the flood.

DENOTTE, IND.—The Halleck Telephone Company has a 150-drop board, 100 subscribers and 250 miles of toll line.

ELIZAVILLE, IND.—The Elizaville Mutual Telephone Company has a Eureka board of 100 drops, and 114 stockholders.

CUMBERLAND, IND.—The Cumberland Telephone Company is of recent formation, has a 50-drop board and 30 subscribers and 6 miles of toll line.

ROCKVILLE, IND.—The Parke County Telephone Company operates a 400-drop board, has 360 subscribers and 120 miles of toll line, with 50 more projected.

NEW PARIS, IND.—The New Paris Mutual Telephone Company has 160 subscribers. There is a fine outlook for rural lines, and 30 toll lines are already in operation.

SULLIVAN, IND.—The Sullivan Telephone Company operates a 450-drop board and has 405 subscribers. There are 100 miles of toll line. Rates are $1 and $2; tolls extra.

ROACHDALE, IND.—The Roachdale Union Telephone Company operates two boards of 100 drops each and has 310 subscribers. Recent growth has been most satisfactory.

SEYMOUR, IND.—The Seymour Home Telephone Company is growing steadily. It operates a 400-drop board, has 375 subscribers and 20 miles of toll line at $1.25 and $2.25.

SHANNONDALE, IND.—The Shannondale Company has a board of 100 drop capacity, fifty drops being installed. There are 142 subscribers, 20 toll lines and other party lines.

VEEDERSBURG, IND.—The Veedersburg Telephone Company has a switchboard capacity of 300 drops, 250 of which are installed. There are 300 subscribers and 7½ miles of toll line.

COLUMBUS, IND.—The Citizens Telephone Company has 1,000-drop switchboard capacity, 1,100 subscribers and 100 miles of toll line. There are numerous exchanges about the country.

FORT WAYNE, IND.—The Home Telegraph & Telephone Company has switchboard capacity of 8,000 drops, 2,700 of which are in service, with 2,700 subscribers. Large cable extensions are projected.

INDIANAPOLIS, IND.—The French Lick, Elon and Eckerty Telephone Company has increased its capital stock from $930 to $1,420. The company proposes to install two new modern switchboards.

BLOOMINGTON, IND.—The Bloomington Telephone Company operates a 700-drop board and has 635 subscribers. It is connected with several rural lines, but does not own any, and has free service all over this section.

BRISTOL, IND.—The Bristol Telephone Company has a 100-drop board, with 50 in operation. There are 50 subscribers, 17 miles of toll line and 20 miles of farmers' lines soon to be completed. Rates are $1 and $1.50.

WALKERTOWN, IND.—The telephone here is operated by Mr. C. A. Lemert, who proposes putting in an exchange at North Liberty. He operates a 100-drop board, has 65 subscribers and 20 miles of toll line.

TIPTON, IND.—The Tipton Telephone Company has switchboard capacity of 440 city and 30 country party line drops. There are 500 subscribers and 40 miles of toll line leased and owned. The rates are $1 and $2.

INDIANAPOLIS, IND.—The Converse Telephone Company, of Converse, has filed articles of incorporation. The capital stock is $12,500. B. F. Agness, W. J. Stillwell, J. J. Sumpter, George T. Randall and W. J. Castler are the incorporators.

NEW MARKET, IND.—The New Market Telephone Company has a 200-drop board, 90 installed, and 190 subscribers, who use 63 miles of line free. The company is co-operative, each stockholder paying $3.65 per year and 15 cents for service.

FAIRMOUNT, IND.—The Fairmount Telephone Company operates the common return system and has lately installed 100 country telephones at $1 per month. There is a 300-drop board, 250 city and 100 country subscribers and 45 miles of toll line.

KENTLAND, IND.—Mr. W. K. McCrary is the owner of the Home Telephone Exchange. Three hundred and ten subscribers are being afforded service from a 200-drop board. There are 50 miles of toll line and several farmer's lines are in course of construction.

WINCHESTER, IND.—The Winchester Telephone Company has increased its capital stock from $25,000 to $50,000 in order to make necessary improvements and extensions to accommodate the rapidily increasing business. Alonzo L. Nichols is president and J. A. Browne, secretary.

WEST LEBANON, IND.—The Cadwallader Telephone Company is now giving night service at State Line and at Marshfield. It operates two switchboards of 100 drops each, with 100 subscribers at the latter and 160 at the former place. It has 60 miles of toll line. Its rates from $1 to $3.

JONESBORO, IND.—The business of the Home Telephone Company of this city has increased to such an extent in this vicinity that the two exchanges controlled by the company, one here and one at Gas City, will be enlarged by the addition of switchboards capable of accommodating from 200 to 300 more subscribers.

RENSSELAER, IND.—The Jasper County Telephone Company has 300 miles of toll line all metallic. Farmers' lines are also metallic and have 10 subscribers on each line. The 800-drop board gives good service to 725 subscribers. Rates for business houses and residences are $2 and $1 respectively; farms $1.50 per month.

GREENSBURG, IND.—The Decatur County Independent Telephone Company has a central energy switchboard capacity of 500 line and 200 party lines. It has 1,100 subscribers. There are 1,475 miles of wire, of which 246 is toll line. The company's business is increasing rapidly and about half of the subscribers are stockholders.

BEDFORD, IND.—The Bedford Home Telephone Company has 480 drops installed, 250 subscribers and 60 miles of toll line. It has just completed a line to Mitchell which gives through connection with West Baden and French Lick Springs. In this way the company reaches Louisville and all long distance points in Kentucky and Indiana.

ROCHESTER, IND.—The Rochester Telephone Company has recently adopted the Stromberg-Carlson "lockout" system for its country lines which cover a radius of 10 miles. It is very satisfactory and the demand for telephones is increasing. The switchboard capacity is 600 drops, 400 of which are installed. There are 375 subscribers and 137 miles of toll line.

BROOKVILLE, IND.—The stockholders of the Brookville Telephone Company have elected the following directors: J. C. Shirk, W. A. Koehler, M. H. Irwin, J. H. Masters and James Beckley. In turn the directors elected J. C. Shirk, president; M. H. Irwin, secretary, and W. A. Koehler, treasurer. Steps were taken at this meeting to improve the plant and extend the lines.

WARREN, IND.—Mr. W. R. Lowe recently bought the exchanges at Warren and Van Buren and has combined the names in the title of his company. The towns are eight miles apart in the heart of the oil region. The switchboard capacity is 400 drops and there are 380 subscribers with 20 miles of toll line. Two thousand three hundred feet of cable are now being put in.

FORT WAYNE, IND.—The National Telephone & Telegraph Company has exchanges at Auburn, Kendallville, New Haven, Ind., and Sturgis, Mich. The general offices are at this place. It has 1,000 subscribers and about 1,000 miles of toll line. Rates are $12, $18 and $24. Cable extensions and toll lines are projected. The company reports a steady increase of business on all lines.

WABASH, IND.—The Central Union Telephone Company's franchise for this city does not expire until next March. It has been announced that the company's franchise had expired and that the company would be ousted. It is believed that the company will not ask for a renewal of rights to operate, but will be content to maintain a toll station, the Home company having preempted the local patronage.

LOGANSPORT, IND.—The Logansport Home Telephone Company has increased its capital stock from $150,000 to $350,000, and will issue bonds to be secured by mortgage on the property of the company. This step is for the declared purpose of making extensions and improvements of the company's plant, which is to be the central point for the consolidated lines of northern Indiana. Walter J. Uhl is secretary.

RIPLEY, IND.—The Farmers' Co-operative Telephone Company operates three boards of 10, 100 and 100 drops. It gives service to 300 subscribers and has 200 miles of toll line. Rates are $10 to stockholders, and $1 to $1.25 to subscribers per month. The company is building farmers' lines as fast as it can, placing ten on one line, and extending to two other counties. It connects with numerous cities and towns also.

FRENCH LICK, IND.—The Star Telephone Company has a 100-drop board, 90 installed, and 92 subscribers. Two new boards are to be put in, one at West Baden. This company has the contract to handle the independent long distance business for the two mineral spring resorts, and in view of the fact that little less than 100,000 people visit them every year, it is to be expected that there will be a prosperous season for the Star Company.

CAMBRIDGE CITY, IND.—The Citizens' Telephone Company has a 400-drop switchboard capacity of which 350 are installed. The apparatus used is of Kellogg, Monarch and Eureka make. There are 650 subscribers at $1 for dwellings, $1.50 for business houses, and 110 miles of toll line. With a population of 2,000, the city supports 240 telephones; the others are within a radius of six miles and the demand exceeds the company's ability to build.

GOODLAND, IND.—The Western Indiana Telephone Company uses Western Electric apparatus and has a 200-drop board with 250 subscribers. There are 32 miles of toll line and 63 of county lines. Business rates are $24; residences, $12; rural, $15. The company is now building on its own property and will equip the exchange with three 100-drop sections and toll board, with 1,500 feet of cable, probably underground. The toll board will carry seven Central Union circuits, four of its own and 12 rural circuits.

RICHMOND, IND.—The directors of the Home Telephone Company have instructed their superintendent to proceed to order the necessary cable, switchboards and other materials to increase the capacity of the plant to 5,200. There are now over a hundred contracts and applications on hand and others in sight awaiting these extensions which will be pushed as rapidly as possible. The company will also purchase some additional copper toll wire with a view to increasing long distance facilities in Western Ohio and northeastern Indiana.

FARMINGTON, IA.—The Farmington Telephone Company uses American Electric apparatus, has a 100-drop board and 60 subscribers.

SPRINGVILLE, IA.—The Springville Telephone Company operates an American 60-drop board and has 50 subscribers at $1 per month.

HEDRICK, IA.—The Hedrick Telephone Company operates a Kellogg 200-drop board and has 250 subscribers, with 50 miles of toll line. Farmers' lines are soon to be built.

PLEASANTON, IA.—The Pleasanton Telephone Company gives service to 60 subscribers from a 100-drop board. It has 80 miles of toll line and will build farmers' lines.

REDFIELD, IA.—The telephone line here has 20 miles of toll line and gives service to nearly all the farmers in the vicinity. Messrs. Nelson and Thornburg are the principal owners.

OAKVILLE, IA.—The Oakville Telephone Company has a 100-drop board, 325 subscribers and 66 miles of toll line. Connection is projected with independent lines of Illinois. There is a great demand for telephones.

WILLIAMSBURG, IA.—The Williamsburg Telephone Company has increased its capital stock from $10,000 to $25,000. It has a 250-drop board with 475 subscribers and 30 miles of toll line. Service costs $1 per month.

ROLFE, IA.—The Rolfe Telephone Company gives service to 195 subscribers in town and 156 on farm lines. The switchboard capacity is 193 drops. There are 20 miles of toll line and 50 farm lines have been put in this season.

ARLINGTON, IA.—The Arlington Telephone Company operates an 80-drop board and is about to build several farmers' lines for which there is a great field. From 300 to 400 telephones will probably be in operation before winter.

FAIRFIELD, IA.—The Jefferson County Telephone Company operates a Eureka 500-drop board and has 456 subscribers, with an expected increase. There are 75 miles of toll line. About 4,000 feet of cable will be put in soon.

IOWA CITY, IA.—The Johnson County Telephone Company, like most of the independent companies, is paramount in its own section. It has 810 subscribers and 210 miles of toll line. Rates are $18 and $30. Numerous improvements are projected.

WEST BRANCH, IA.—The West Branch Telephone Company operates a 100-drop board, with 110 town subscribers and 200 farmers. It has 35 miles of toll line. Extensions are projected. The lines have been practically rebuilt owing to the increased demand.

NEVADA, IA.—The Nevada Mutual Telephone Company's switchboard is of 500-drop capacity with 300 installed. It has 360 subscribers and toll lines of 75 and 60 miles respectively, also farmers lines, with more of the latter to come. Its rates are $2 and $1.25.

SHELL ROCK, IA.—The Shell Rock Telephone Company operates a 100-drop board with 80 subscribers. There are nearly 800 miles of toll line. Three new lines with 17, 14 and 12 subscribers are to be built. Three already in working order have 17, 14 and 8 subscribers.

WASHINGTON, IA.—The Washington Telephone Company operates a 500-drop board, has 385 subscribers and 80 miles of toll line. The company is installing 13,000 feet of cable and is doubling its capacity, besides putting in a new farmer and toll line board for 50 lines.

LA PORTE CITY, IA.—The La Porte Public Utility Company comprises water, electric light and power systems as well as telephone. The latter operates a switchboard of 300 central energy signals, 50 drops for farm lines, with 215 city subscribers and 200 farmers. Rates are $12 and $18.

STOCKPORT, IA.—The Union Telephone Company consists of four principal exchanges. Keosauqua, Bonaparte, Stockport and Birmingham, with drop boards of 100, 100, 40 and 65 respectively. There are five rural party lines with 300 connections and toll lines connecting all surrounding towns. Rates are $1 to $1.50 per month.

MANHATTAN, KAN.—The Wareham & Wood Telephone Company uses Sterling apparatus. It has a 400-drop board and 450 subscribers. There are 30 miles of toll line.

GALENA, KAN.—Messrs. Williams & Robinson are the owners of the Galena Telephone Company and report bright prospects for business in their section. They operate a 700-drop board, have 500 subscribers and 80 miles of toll line. An increase and a new exchange at Scammon are projected.

CARLISLE, KY.—The Carlisle Telephone Company is extending its lines and making good progress. It has a 400-drop board and 378 subscribers; also 28 miles of toll line.

VINEYARD HAVEN, MASS.—The Public Telephone Company operates a 260-drop board, has 117 subscribers and 175 miles of toll line. A large increase in capacity is projected. The company is holding its own in spite of keen competition.

CANTOR, MINN.—The telephone station here is managed and owned by Mr. J. Dunford. It has 300 subscribers and nearly 150 miles of toll line; also many farmers' lines with 18 to 24 on a line. Improvements and additions are projected.

THIEF RIVER FALLS, MINN.—The telephone station here is owned by Mr. H. Frant. It operates a 200-drop board and has 192 subscribers. A 60-mile toll line has been laid out, 10 miles of which are completed. Local lines are also to be built.

HARTVILLE, MO.—The Hartville Telephone Company uses a Stromberg-Carlson 50-drop board and has 43 subscribers. There are 64 miles of toll lines. The outlook for telephone business in this section is fine.

JULIAN, NEB.—The Julian Telephone Company operates a Eureka 100-drop board, has 50 subscribers and 20 miles of toll line.

NELIGH, NEB.—The Northwestern Telephone Company operates a 200-drop board here, has 170 subscribers and 15 miles of toll line. Its rates are $2 and $1, and 15c. for party lines.

CREIGHTON, NEB.—The Camp Dewey Telephone system is making rapid progress and has to enlarge its switchboard capacity. It now has 250 miles of toll line and is about building 75 miles more. There are 198 subscribers.

TUCKERTON, N. J.—The Atlantic Burlington & Ocean Telephone Company operates a 100-drop board, has 16 subscribers and 10 miles of toll line.

STAMFORD, N. Y.—The Stamford Telephone Exchange operates a 100-drop board with 60 subscribers. It proposes putting in a new switchboard and new cable.

WOODHULL, N. Y.—The Woodhull Telephone Company operates a few miles of toll line, but there is every prospect of every road in the district being utilized for telephone extensions.

ALDEN, N. Y.—The Alden Telephone Company has not been operating long, but expects to increase its sphere of work soon and to have long distance connection. It has a 100-drop board and 25 subscribers.

COHOES, N. Y.—The Cohoes-Waterford Home Telephone Company has been installed only two months, but is doing extremely well. It operates 800 drops of a board of 3,000 capacity and has 500 subscribers at $40 to $20 per year.

MARS HILL, N. C.—The Ivy Telephone Company, of Mars Hill, is contemplating several extensions.

SALISBURY, N. C.—The Salisbury Telephone Company is building a system in Spencer, about 100 telephones being installed in the new plant.

ASHEVILLE, N. C.—The Asheville Telephone Company and the Southern Bell Telephone Company have conditionally consolidated. A new corporation will be created provided the city grants the desired franchise. The consolidation will mean higher rates and the dismantling of the Bell system.

OXFORD, OHIO.—The Oxford Telephone Company will extend its system under the supervision of the county engineer.

NEWARK, OHIO.—The Newark Telephone Company has been authorized to increase its capital stock from $60,000 to $100,000.

JEFFERSON, OHIO.—The Jefferson & Warren Telephone Company has been making some needed improvements to its lines in this place. Considerable new cable has been stretched.

COLUMBUS GROVE, OHIO.—The village council has granted a franchise to the Mutual Telephone Company to enter this city. The company is made up mainly of farmers who desire connections with the city.

ST. MARYS, OHIO.—The stockholders of the St. Marys Telephone Company have decided to enlarge the plant to about twice the present size. The capital stock of the company will also be increased to $60,000.

DILLONDALE, OHIO.—The Vigilant Telephone Company at a recent meeting appointed a committee to solicit subscribers and also consider a proposition to combine with two other companies and build lines direct to Mingo Junction.

CANTON, OHIO.—The Stark County Telephone Company will expend about $80,000 during the next three months in enlarging its exchange in this city. Other large sums of money will be spent in extending the lines to all parts of Stark and adjacent counties.

FREMONT, OHIO.—The Fremont Home Telephone Company will soon increase its capital stock from $60,000 to $100,000. Part of the increase will be expended for a new switchboard to take care of the rapidly increasing business. The company has about 750 exchange subscribers and nearly 50 farm line subscribers. It has about ten miles of metallic circuit toll lines.

OTTAWA, ONT.—As soon as its charter is granted by the Dominion parliament, it is the intention of the Canadian Telephone Company to institute a special rural system in Canada, in an effort to make the telephone as popular as the post office. It is prepared to give a long distance service for about half the present rates charged by the Bell Company. Subscribers in cities like Montreal, Toronto and Ottawa will be given a 20-mile circuit without extra cost above that paid for their telephones.

CHESTER, PA.—The United Telephone Exchange was struck by a tornado on July 3 and set on fire, the loss being $5,000.

WAINSBURG, PA.—The South Penn Telephone & Telegraph Company will build a telephone line in Green County. Mr. M. R. Travis is one of the directors.

BALLINGER, TEX.—The Central Texas Telephone Company has a 210-drop board and 160 subscribers.

OGDEN, UTAH.—The Rocky Mountain Bell Telephone Company has begun the work of building underground conduits for its system and it will not be long before the city is free from overhead wires.

SALT LAKE CITY, UTAH.—The directors of the Rocky Mountain Bell Telephone Company have authorized the purchase of the plants of the Powder River Telephone Company and the Sheridan Telephone Company in central and eastern Wyoming, which will add 325 miles of line to the system.

CLAREMONT, VA.—The Claremont Telephone Company operates a 50-drop board and has 42 subscribers and 15 miles of toll line.

ELECTRIC LIGHT AND POWER.

CLIFTON, ARIZ.—Preliminary surveys are being made for the establishment of a large electric power and transmission plant, to be located on the Blue River. The survey is in charge of A. F. Johns, an engineer of San Francisco. It is stated that the actual work of construction will begin as soon as the preliminary arrangements can be made. The electrical energy is to be transmitted to Clifton and Morencia where it will be utilized in the mines and smelters and for domestic purposes.

FT. SMITH, ARK.—It is stated that Col. Ira Oglesby is preparing an ordinance for an electric light plant.

PINE BLUFF, ARK.—Douglas C. Bell has recently bought the plant of the Citizens Light & Transit Company, of Pine Bluff, the consideration being $15,000. Chas. Senyard was the former owner.

SAN FRANCISCO, CAL.—It is stated that bids are wanted about August 1 for constructing the 10,000-hp water power of Kaweah River Power Company, at an estimated cost of $1,000,000. Leon M. Hall, 814 Hayward Building, San Francisco, is the engineer.

MACON, GA.—Twenty-five thousand horse power is being developed from the Ocmulgee River near Macon, to secure power for generating electricity for Macon and other towns. The cost will be about $500,000. Henry Horne, of Macon, is said to be interested. A dam is also being built near Milledgeville on the Ocomee River.

ALTON, ILL.—The Alton City Council will consider at its next meeting a proposition for lighting the city with enclosed arc lamps in the place of the present system of open-arc lights. The company now lighting the city of Alton, the Alton Railway, Gas and Electric Company, will make the proposition for the new contract.

EDWARDSVILLE, ILL.—A controversy of several years standing was ended July 8, when the City Council of Edwardsville granted a franchise to the Edwardsville Electric Light & Power Company for a period of seven years, and entered into contract with the company to furnish the municipal lighting. The new franchise provides a rate of $75 a year for city arc lights, operated every night; commercial lighting at 12c. per kw-hour net on incandescent circuits, with no charge for meters or meter rental. A clause provides that the city may purchase the plant at the expiration of five years.

CONVERSE, IND.—The Converse Electric Company has been incorporated, with a capital of $12,500, by J. A. Henry, J. J. Sumpter, and others.

ANDERSON, IND.—The Westinghouse Electric & Mfg. Company has contracted to supply a turbine engine for the city electric light plant for $19,250.

COLUMBUS CITY, IND.—It is proposed to improve the electric light plant at a cost of about $5,000. There will be required one horizontal tubular boiler, one side crank engine of 150-hp; one 100-kw alternator, steam pipe fitting, etc.

LOGANSPORT, IND.—Bids will be received by the Electric Light Company of the City Council until August 31 for furnishing two high-pressure steam boilers having a capacity of 350 hp each. A. D. Fansler is City Clerk.

RICHMOND, IND.—Bertram & Storrs, of New York, have purchased the property of the Richmond Light, Heat & Power Company. The consideration is said to have been $100,000, the purchasers paying 50 cents on the dollar for the $200,000 worth of bonds of the local company, with the stock thrown in. The purchasers will be compelled to compete with the municipal plant, which will relieve the company of the street lighting next year.

BUHL, MINN.—The Northern Electrical Company, of Duluth, Minn., has secured the contract for constructing the electric light plant at Buhl.

ST. CHARLES, MINN.—The contract for constructing an electric light plant has been awarded to the American Electric Company, of St. Paul, Minn., for $9,990.

ST. LOUIS, MO.—The Union Electric Light & Power Company, formerly the Citizens' Electric Light & Power Company, has made application for a permit to erect a $500,000 power house on the river front between Ashley and Biddle Streets.

MEXICO, MO.—A company composed of S. M. Locke, president; J. W. Wooldridge, vice-president; F. A. Morris, secretary and treasurer, and E. R. Locke, has purchased the Mexico Electric Company's plant from Messrs. Thomas Waddell, Harry Rubey and W. E. McCully, of Macon City, for about $35,000.

CLAYTON, MO.—The Valley Park Electric Company has filed articles of incorporation. The incorporators are William W. Darley, W. J. Vance, Jas. H. Beal and R. T. Rossell, of Pittsburg, Pa.; George W. Easley, Lon O. Hocker and Edward T. Miller, of St. Louis. The capital stock is $50,000. The object of the company is to furnish current for light, heat and power in Valley Park (a suburb of this city) and the adjacent country.

GUILFORD COLLEGE, N. C.—The sum of $1,000 has been donated to Guilford College for the erection of an electric lighting plant.

MICAVILLE, N. C.—The Estatee Electric Company, of Micaville, has been chartered with $125,000 capital by Geo. D. Miles, of Chicago, W. W. Chapman, of Micaville, and others.

CHARLOTTE, N. C.—It is reported that Geo. W. Vanderbilt will build a model manufacturing town between Hendersonville and Brevard, N. C., with complete systems of electric lights, heating, power and water.

NEWARK, N. J.—Bids for lighting the city with electric lamps for two and five years were received from the United Electric Company on June 18, by the Board of Works. The company offered to furnish the standard type of open arcs for two years for $98.55 per lamp, and enclosed arcs for five years at $95 each.

FREEPORT, L. I., N. Y.—The citizens voted to expend $3,000 to extend the commercial lighting system, and $6,000 for extending the water works. S. P. Shea is Village Clerk.

VALATIE, N. Y.—James E. Snyder, of Valatie, and John Snyder, of New York, have purchased the Valatie electric light plant. It is reported that they will install an entirely new plant and give the village all-night service.

POTSDAM, N. Y.—W. H. Walling and H. B. Batcheler are ready to receive bids for material for a new concrete dam which is to be built by the day. This work is preparatory to the construction of a municipal electric light plant.

SANTA FE, NEW MEX.—It is announced that the Capitol Light & Power Company will begin the construction of its large electrical generating plant, to be located on the Pecos River about August 1. The stockholders of the company are for the most part residents of Toledo, Ohio. J. H. Webster, of Denver, Colo., is connected with the enterprise. The company proposes to build transmission lines to Santa Fe, Las Vegas and Albuquerque.

BRILLIANT, OHIO.—The Steubenville Traction & Light Company is preparing to furnish electric light in Brilliant.

COLUMBUS, OHIO.—The State will install an electric lighting plant at the State encampment grounds near Newark.

CLEVELAND, OHIO.—The Board of Public Service has been authorized to expend $5,000 in having plans prepared for the proposed municipal lighting plant which will be operated in connection with the new water works pumping station.

SPRINGFIELD, OHIO.—The lighting plant of the American Railway Company, of Philadelphia, which is located in this city, has been purchased by the Springfield Light, Heat & Power Company for $350,000. The works will be enlarged.

DILLONVALE, OHIO.—The village will vote on a proposition to issue $35,000 of bonds for the purpose of building an electric lighting and water works plant. The measure will probably pass. Twenty-five arc lamps will be installed, together with the necessary generating equipment.

BAKER CITY, ORE.—It is announced that the General Electric Company has been awarded the contract for all the necessary machinery for the Rock Creek Power & Transmission Company's power plant near this city. The plant will furnish electrical power for transmission to this city.

PORTLAND, ORE.—The Portland General Electric Company is stated to have secured the contract for lighting the streets and city buidlings for one year. The contract calls for 850 street arc lights, which will be maintained for $4,500 a month. Additional lights will cost $5.30 each a month.

BAKER CITY, ORE.—The Baker City Gas & Electrical Company is making rapid progress in the re-establishment of its power plant. The engine is now being installed, and the plant will be in operation by August 1. Many manufacturing enterprises will be started as a result of the installation of the plant, including flouring and woolen mills. Work is also being pushed on the power plant will be in operation by the end of the present year.

M'KEESPORT, PA.—It is stated that the Altmyer Light & Power Company is to install an electric light and power plant in McKeesport, at a cost of $150,000.

ROCK HILL, S. C.—The Catawba Water Power Company, of Rock Hill, has increased its capital stock from $250,000 to $650,000.

WINNSBORO, S. C.—Bids will be received by the Town Council for a municipal lighting plant, of 35 arc and 600 incandescent light capacity. W. B. Smith, Whaley & Co., Columbia, are the engineers.

DICKSON, TENN.—It was voted June 23 to construct water works and an electric light plant.

GRANDVIEW, TEX.—W. B. Head is stated to have secured a franchise for an electric light plant.

LAREDO, TEX.—Local capitalists contemplate erecting an electric power plant on the Rio Grande at a point about 25 miles above here. C. C. Pierce, of Laredo, can probably give information.

MARLIN, TEX.—Prof. T. U. Taylor, of the engineering department of the State University at Austin, has made an examination of the Brazos River at a point near here with the view of determining the amount of water power available for an electrical generating plant which Captain J. A. Martin, B. C. Nettles and other citizens of Marlin contemplate establishing. It is stated that Prof. Taylor's report is very favorable and that further steps towards carrying out the project will soon be taken.

SPRINGVILLE, UTAH.—The $20,000 bonds authorized to be issued by this city for the installation of an electric plant have been sold to E. H. Rollins, of Denver, Colo.

PROVO, UTAH.—The Telluride Power Company is making improvements in its plant which will increase the capacity from 1800 to 3000 horse power. The work involves the construction of a flume a distance of eight miles to the mouth of Provo canyon, where a second power plant will be installed.

SPOKANE, WASH.—The Washington Water Power Company has begun surveys for the proposed electric plant to be constructed at Post Falls, which will cost $500,000.

SEATTLE, WASH.—The City Council has granted to F. A. Pieplow, of La Junta, Col., a franchise for electric light plant and a telephone system. The plant will be in operation by the end of the present year.

KILBOURN, WIS.—The Village Trustees are reported to be considering the question of constructing an electric light plant.

LA CROSSE, WIS.—The Council has passed an ordinance ordering all electric wires in the brick paved district underground.

THE ELECTRIC RAILWAY.

HUNTSVILLE, ALA.—A. B. Coryell, superintendent of the Huntsville Electric Railway, Light & Power Company, announces that the company will install a new $25,000 plant to be completed within six months.

TUSCUMBIA, ALA.—The power house to furnish power for the new interurban line of the Tuscumbia, Sheffield & Florence Street Railway in Alabama is now being erected and the line will probably be started up by November 1.

HARTFORD, CONN.—The Manila Electric Railroad & Power Company has been organized under the laws of Connecticut, with an authorized capital stock of $6,000,000, par value of shares $100 each. A holding company of similar name was incorporated in New Jersey last spring, but the present company, formed under the more liberal laws of Connecticut, owns the franchise and rights in Manila.

CARTERSVILLE, GA.—The Everett-Moore Syndicate, of Toledo, O., has agreed to build an electric railway from Athens to Cartersville, Ga., if the people along the route will give $30,000 and the right of way. A preliminary survey will be made.

ATLANTA, GA.—The Atlanta Interurban Railway Company has been incorporated with a capital stock of $100,000 to build the proposed electric railway between Atlanta and Marietta. Interested in the company are Georgia Railway & Electric Company interests. The incorporators of the company are: P. S. Arkwright, G. W. Brine, T. K. Glenn, W. H. Glenn, H. N. Hurt, S. E. Simmons, S. J. Bradley, R. E. Cullinane, W. B. Stoval and F. M. Fisk.

SPRINGFIELD, ILL.—The articles of incorporation of the Springfield & Southwestern Railroad Company have been filed. The capital stock of the company is $25,000. The incorporators and first board of directors are: J. W. Maunts, G. D. Chaffee, Max Kleeman, T. F. Dove, of Shelbyville, and C. Weekley, Obed, E. D. Kerr, Brunswick, and R. P. Smith, of Moweaqua, all citizens of Shelby County.

FT. WAYNE, IND.—The Ft. Wayne and Springfield Railroad Company has been incorporated. The capital stock of the company is $300,000. The promotors are: William H. Fedderjohann, John H. Koenig, Henry J. Happel and others.

INDIANAPOLIS, IND.—The French Lick & West Baden Electric Railway Company has filed articles of incorporation, with a capital stock of $30,000. The incorporators are Thomas Taggart, William A. Holt and B. J. T. Jeup. Thomas Taggart is president and Maurice Donnelly secretary.

ANGOLA, IND.—The Goshen & Indiana Traction Company, incorporated to build a line from Goshen to Angola, Ind., has changed its name to the Northern Indiana Railway Company, and filed a mortgage to the Colonial Trust Company, of Pittsburg, as trustee, to secure $3,500,000 of fifty-year bonds.

INDIANAPOLIS, IND.—The capital stock of the Indianapolis & Cincinnati Traction Company has been increased from $1,500,000 to $2,000,000. The stockholders at the same time ordered a bond issue of $4,000,000. The entire stock issue and $2,000,000 of the bonds have already been sold to Indianapolis capitalists.

LAFAYETTE, IND.—The directors of the Lafayette Street Railway Company have voted to turn the road over to the Fort Wayne, Logansport & Lafayette Traction Company. Superintendent C. D. Emmons, of the Lafayette Company, will become general manager of the Traction Company, with headquarters at Fort Wayne. This is the beginning of the merger system.

DES MOINES, IA.—The articles of incorporation of the Western Iowa Interurban Railway Company have been filed. The capital is $100,000. President, J. A. Nash; secretary, C. R. Benedict.

DES MOINES, IA.—The Illinois & Iowa Railway Company, of Clifton, has given notice of increase of its capital stock to $1,500,000. The increase was made necessary by the intention of the company to complete the interurban line between Clinton and Davenport at once. This is the company which has been promoted by Thomas Wilcox, of Des Moines. The road is now under construction.

LOUISVILLE, KY.—Articles of incorporation of the Louisville & Cincinnati Interurban Railway Company have been filed in Indianapolis. The step is the culmination of plans formed quietly by capitalists of Louisville, New Albany and Jeffersonville, the intention being to operate a direct interurban line to Cincinnati. It is announced that all arrangements have been made and the work of construction will begin shortly. The capitalization has been fixed at $50,000, this being, of course, a nominal sum for temporary use. The directors are: George B. Lewman, president of the First National Bank; John F. McCulloch, of New Albany, Ind.; John C. Zulauf, of Jeffersonville, Ind., and Louis Hartman, of New Albany.

WORCESTER, MASS.—The new trolley line between Worcester and Boston was opened for traffic on July 1.

NEWTON, MASS.—The Newton Street Railway Company has petitioned the Railroad Commissioners for authority to issue $185,000 additional capital stock for improvements and additions.

BOSTON, MASS.—The Worcester & Holden Railway Company has petitioned the Railroad Commissioners for authority to issue $100,000 5 per cent. twenty-year bonds, and $50,000 stock to fund floating debt and to purchase new equipment and real estate.

BOSTON, MASS.—The Boston & Worcester Street Railway Company has petitioned the Board of Railroad Commissioners for authority to issue $1,000,000 4½ per cent twenty-year bonds and $250,000 stock for the purpose of building and equipping its road.

WHITINSVILLE, MASS.—The Selectmen of Northbridge have voted to grant a franchise to the Uxbridge & Blackstone Street Railway Company for an extension of its track to connect at Whitinsville with the Linwood Street Railway.

BATTLE CREEK, MICH.—The Grand Rapids & Southern Michigan Traction Company has been incorporated, with a capital stock of $1,300,000. The stockholders of the company are: Arthur J. White, Edward F. Pangborn and Alfred E. Poulsen, of Battle Creek.

JACKSON, MICH.—Articles of incorporation have been filed by the Jackson, Ann Arbor & Detroit Traction Company, with a capital stock of $2,500,000. The stockholders are: William Halls, Jr., Summit, N. J.; U. S. Potter, Jackson, Mich.; Leonard H. Hole, Montclair, N. J.; William N. Color, Jr., Newark, N. J.; W. A. Boland, Yonkers, N. Y.; Henry R. Carse, New York, N. Y., and George W. Mechem, Battle Creek, Mich.

HAGERSTOWN, MD.—The Chambersburg, Greencastle & Waynesboro Electric Railway Company has purchased the electric plant of the Waynesboro Electric Light & Power Company. A mortgage for $300,000 against all the property of the former company has been put on record. Bonds amounting to $250,000 only are to be issued against the mortgage.

BELVIDERE, N. J.—The Easton (Pa.) & Belvidere (N. J.) Street Railway Company has awarded the contract to build its railway to the Railway Construction Company of America, with offices in the Exchange Building, Boston, Mass., and work will begin at once. The directors are: W. S. Reed, Leominster, Mass.; Charles A. Shipper, Milford, Mass.; Michael J. McGawley, Boston; John McGawley, Lowell; E. B. Fullen, Haverhill, Mass., general counsel; Charles A. Richardson, Boston, general manager, and Howard Mitchler, of Easton, Pa.

BROOKLYN, N. Y.—The Postoffice Department has issued a fraud order against the American Street Car Transportation Company of Brooklyn. The company advertised to sell for one cent each, tickets good on any electric and elevated street car in the United States. This it did by an "endless chain" scheme, whereby, in order to obtain 25 cents worth of one-cent tickets, it would be necessary for the applicant to sell three "introducers" at 25 cents each to his friends, and for each of the three friends to return their "introductions" to the company with 75 cents, with which to supply in turn three of their friends, with "introductions." The company operatel in many cities, and by its methods caused street railway managers much annoyance.

JOHNSTOWN, N. Y.—The extension of the trolley system of the Fonda, Johnstown & Gloversville Railroad Company from Amsterdam to Schenectady, has been formally opened for traffic.

NEW PALTZ, N. Y.—The property of the New Paltz & Poughkeepsie Traction Company has been sold under foreclosure to Charles J. Rowe, of New Jersey, representing some bondholders, for $200,000. The Franklin Trust Company was the trustee under a $100,000 mortgage.

ONEONTA, N. Y.—On the application of attorneys for Oneonta creditors of the Oneonta, Cooperstown & Richfield Springs Railway Company, Judge Mattice has appointed Herbert T. Jennings receiver. Liens aggregating $100,000 have been filed in Otsego and Herkimer counties.

NEW YORK, N. Y.—E. Hanson, president of the Havana Electric Railway Company, announces that financial arrangements have been completed in London for a very considerable extension of the Havana electric railway system. It is stated that in due course the Havana Railway will have 100 miles of track.

NEW YORK, N. Y.—The Brooklyn Rapid Transit Company broke all previous big traffic records on the Fourth of July. Two million passengers were carried on the surface and elevated roads. Although the cars and trains were run without any regular schedule, there was not a single casualty, and only a few minor mishaps and delays. Sunday, July 5, was another big record day.

KINGSTON, N. Y.—The property and franchises of the New Paltz & Poughkeepsie Traction Company, which operates over the Poughkeepsie Bridge, has been sold at auction under foreclosure of a mortgage by the Franklin Trust Company, of New York, to Charles J. Rowe, a New Jersey lawyer, for $20,000. The mortgage was for $1,000,000. Rowe is believed to represent the Franklin Trust Company.

UTICA, N. Y.—A report has been received in this city to the effect that as soon as the electric railway from Johnstown to Schenectady has been completed it will be transferred to the New York Central. It is said also that the franchise held by the electric line will permit the use of steam power as well as electricity. The line runs through the streets of Amsterdam. The Johnstown-Amsterdam line is already in operation and the section from Amsterdam to Schenectady is nearly completed.

ITHACA, N. Y.—The Ithaca & Cortland Traction Company has filed papers of incorporation. The capital stock of the company is $200,000. The road will be 20 miles in length. The directors for the first year are: Howard L. Chandler, Philadelphia, Pa.; Curtis J. Harrington, New York; Ogden Armstrong, Philadelphia, Pa.; Francis S. Howell, of Philadelphia, Pa.; James D. Staley, of Philadelphia, Pa.; George F. Archer, of Camden, N. J.; E. H. Chandler, of Atlantic City, N. J., and C. Taylor Leland, of Philadelphia, Pa.

CONNEAUT, OHIO.—The capitalists who are building the Conneaut & Erie Electric Railway have decided to lay a branch line from Girard south to Albion, Pa. Work will be started soon after the main line is completed.

MARION, OHIO.—The Marion Railway, Light & Power Company has been incorporated, with a capital stock of $500,000. The incorporators are: John G. Webb, W. A. Black, O. T. Martin, T. Troupe and W. S. Rabbits.

CINCINNATI, OHIO.—The Cincinnati, Milford & Loveland Traction Company has purchased the privileges and interest of the Cincinnati, Milford & Eastern Traction Company. The purchase price was said to be between $60,000 and $70,000.

DAYTON, OHIO.—The capitalization of the Southwestern Traction Company has been increased to $150,000. The capital stock will be increased later to $600,000, when there will be a bond issue in that amount. The road is to be built from Dayton to Camden. Among the prominent Dayton capitalists interested is M. L. Mowrer.

CINCINNATI, OHIO.—Council has decided that the franchises of the Cincinnati Street Railway Company, which are expiring, are not subject to public sale, and cannot be offered in view of the litigation which is pending in connection with the validity of the Rogers law, under which the company holds a 50-year franchise.

COLUMBUS, OHIO.—Charles H. Bosler, of Dayton, Ohio, attorney for the Lebanon & Franklin Traction Company, has filed a certificate of increase of capital stock with the Secretary of State. He stated that the line, which will be 11 miles in length and will run between Franklin and Lebanon, will soon be started. Power will be furnished by the Cincinnati, Dayton & Toledo Traction Company.

FREMONT, OHIO.—The County Commissioners have granted to the Kerlin Bros. Company an extension of franchise for their proposed Tiffin-Fremont electric line. The franchise expired about a year ago, but the Kerlins, by agreeing to repair some of the work already done, have had their grant extended until January 1, 1905. It is intimated that some work may be done on the line this summer.

COLUMBUS, OHIO.—At a meeting of the directors of the Columbus Railway Company and the Columbus Railway & Light Company Robert E. Sheldon resigned as president of the Columbus Railway Company and was elected president of the Columbus Railway & Light Company, of which L. S. Steward was chosen vice-president. Butler Sheldon, son of R. E. Sheldon, was elected to the presidency of the railway company.

ZANESVILLE, OHIO.—The Ohio Power Company, of Zanesville, has filed articles of incorporation, with a capital of $50,000, to operate an electric railway in Zanesville and through the counties of Muskingum, Coschocton, Washington, Perry, Licking and Franklin. The company is also authorized to supply electricity for light, heat and power. F. A. Durban, T. F. Shangley, Charles T. Atwell, W. B. Cosgrove and W. A. Gibbs are the incorporators.

ALLENTOWN, PA.—The charter of the Trexlertown & Alburtis Street Railway Company has been filed. The capital stock is $18,000. H. E. Ahrens, of Reading, is president. The directors are: G. B. Schaeffer, of Fleetwood; John Barbey, John L. Bowman, John R. Miller, Ferdinand Gratz, James R. Mercer and H. E. Ahrens, of Reading.

ALTOONA, PA.—A charter has been applied for in New Jersey for the Johnstown & Cumberland Railways, Light & Power Company, which is to take over a score or more of street and suburban railway and electric light plants in Central and Southern Pennsylvania, between Johnstown, Pa., and Cumberland, Md. The capital stock of the company is $6,000,000. The line will have a mileage of 150 miles.

PITTSBURG, PA.—A new street railway is to be built from Hays Borough south to Currys Station, a distance of about 6 miles. The new line will connect with the Pittsburg Railway Company's lines and with that of the new line to Charleroi. The right of way was secured by E. W. Curran, of Homestead. The capital of the new company is $36,000. The officers elected are: President, F. H. McKinney, of Pittsburg; secretary, E. W. Curran, of Homestead; treasurer, Daniel McSweeney, of Hays.

CHAMBERSBURG, PA.—A resolution of the directors of the South Middleton Railway Company has been entered for record at the Court House. The line is to run from Burnt House to Chambersburg. This line is said to be a part of the system formerly known as the Baltimore, Westminster & Gettysburg Electric Railway, and which will extend from Westminster, Md., to Harrisbug, Pa., between Chambersburg and Cumberland, Md., completing all the gaps between the lines, which would give a total of 150 miles and a direct line from Johnstown to Cumberland, a distance of 72 miles. It will connect thirty or more mining towns that are now practically isolated. Among the companies whose stock and plants will be taken over by the new corporation are the Cumberland & Westernport Street Railway Company, the Lonaconing, Midland & Frostburg Railway Company, which lines are now built and in operation; the Meyersdale & Salisbury Street Railway Company, which is now nearly completed; the lines, stock and rolling equipment of the Johnstown Passenger Railway Company, which includes about 43 miles of railway in operation, and a score or more of electric lighting plants. The Robert W. Hunt Company, of Pittsburg, which designed the $1,000,000 plant of the Pittsburg, McKeesport & Connellsville Street Railway Company, located near Connellsville, has been retained as engineers for the company, and is now drawing up plans for an immense power plant.

NASHVILLE, TENN.—The deed to the property of the Nashville Railway has been transferred to the new owners by Charles C. Trabue, the commissioner appointed by the Federal Court to sell the property. The name of the new company will be the Nashville Railway & Light Company. Percy Warner has been elected president and J. H. Fall, vice-president. The new company will operate both the street railway and the Cumberland Electric Light & Power Company. The Nashville Railway & Light Company will authorize a bond issue of $5,000,000. The Nashville Railway Company, for which a receiver was appointed, had bonds outstanding amounting to about $6,500,000. Of the new issue $2,000,000 will be held in reserve to secure the underlying bonds of the several companies of which the Nashville Railway was composed.

SALT LAKE CITY, UTAH.—The Consolidated Railway & Power Company, it is announced, will soon establish its own electric power plant.

WHEELING, W. VA.—The Fairmount & Clarksburg Traction Company has been incorporated, with a capital stock of $2,000,000. The incorporators are: S. L. Watson, L. L. Malone, C. Powell, Walton Miller and M. L. Hutchinson, of Fairmont. This company is said to be the successor of the Fairmont & Clarksburg Electric Railway Company.

CHARLESTON, W. VA.—The Kanawha Water & Light Company has been granted a franchise for an interurban railway. It plans to connect Charleston with the towns up and down the Kanawha River. The principal stockholders in the company are Senator Elkins and ex-Senator H. G. Davis.

MILWAUKEE, WIS.—The Withee & Maplehurst Electric Railway & Light Company, of Milwaukee, has been incorporated with a capital stock of $50,000. The incorporators are W. J. McElroy, F. C. Eschweiler, and E. H. Naber.

NEW INDUSTRIAL COMPANIES.

THE LIQUID AIR AND X-RAY INSTITUTE, of New York, has been incorporated with a capital of $50,000. Directors: R. H. Jaeger, E. L. Thompson and Banton Moore, New York.

THE NATIONAL ELECTRIC COMPANY has been incorporated in New York City with a capital stock of $10,000, the incorporators being Messrs. Augustus Noll, O. C. Braun and J. C. Corbin.

THE SOUTHERN CAR COMPANY, of High Point, N. C., has been chartered with a capital of $60,000 paid in, and $250,000 authorized. The company will manufacture cars for steam and electric railways.

THE AMSTERDAM ELECTRICAL MFG. COMPANY has been incorporated at Amsterdam, N. Y., with a capital stock of $50,000. The incorporators are Charles D. Austin, Edward McDonnell and Morris Cohn, Jr.

LEGAL.

WESTERN UNION-PENNSYLVANIA.—Judge Morris, at Baltimore, has granted a preliminary injunction restraining the Philadelphia, Baltimore & Washington Railroad from removing from its lines the Western Union poles and wires.

TREE TRIMMING.—The Court of Civil Appeals of Texas, in a suit decided May 16, 1903, held that a telegraph or telephone company which enters on premises abutting a street along which its wires are strung and without the consent of the owner, removed the branches of trees which interfere with its wires, thereby causing the trees to wither and die, makes itself liable for the damage done. It was held that the plaintiff had no right to enter the premises of the defendant without his consent and to injure his trees in the manner that was done.

THE WASHINGTON, BALTIMORE & ANNAPOLIS ELECTRIC RAILWAL COMPANY has been placed in the hands of receivers by Judge Morris, of the United States District Court at Baltimore. This action was taken upon the application of the Cleveland Construction Company, which alleges that it is creditor to an amount of $93,000, and that the railroad company is unable to meet the payment of this amount and its other liabilities. The answer of the railroad company admitted the allegations set forth, and assented to the appointment of receivers. James Christy, Jr., of Akron, O., and George W. Williams, of Baltimore, were appointed receivers.

FAILURE TO DELIVER TELEGRAMS.—In a suit decided in the Court of Civil Appeals of Texas, May 20, 1903, it was held that the defendant, a telegraph company, was not guilty of negligence in the non-delivery of a telegram addressed to "Marvin Cox, traveling picture man," who did not stop in a hotel or boarding-house, but camped in a wagon yard. On June 11 the Court of Appeals of Kentucky rendered a similar decision in the case of a message intended for "an obscure colored woman." It was held that since the woman lived outside of the free delivery limit it was the duty of the sender of the message either to prepay or guarantee the extra delivery fee. In the Supreme Court of Monroe County, Conn., it was held in a suit on appeal that the addressee of a telegram could not recover the penalty for neglect to deliver a telegram, such right being by the statute expressly limited to the sender of a dispatch.

OBITUARY.

CHARLES C. MARTIN, formerly chief engineer of the Brooklyn Bridge, was found dead in bed on the morning of July 11 at the home of his son, Kingsley Martin, in Far Rockaway, L. I. Death, it is stated, was due to apoplexy, superinduced by heat. The deceased was 72 years of age. He was born in Springfield, Pa., and received his technical education in Rensselaer Polytechnic Institute at Troy, N. Y., from which institution he graduated in 1853. Mr. Martin's body was interred at Pittsfield, Mass.

PERSONAL.

MR. J. M. ANDERSON, treasurer of the Albert & John M. Anderson Company, of Boston, Mass., is about to sail for Europe on an extensive trip.

MR. JOHN HAY KUHNS, of Omaha, Neb., is on a short visit to the East on professional business. Mr. Kuhns was assistant electrical engineer of the Omaha Exposition of 1898.

PROF. FRANK W. SPRINGER, of the University of Minnesota, is making a professional tour of inspection of Eastern electrical works and new or enlarged operating plants previous to entering on his vacation.

MR. CHARLES CLEGG, general manager of the Mexico City Electric Traction system, which is controlled by Wernher, Beit & Co., of London, has left for the Southern Republic, after a short visit to the States.

MR. A. A. KNUDSON presented at the recent Detroit Convention of the American Water Works Association a paper entitled "Some Recent Effects of Electrolytic Action upon Underground Mains and Other Metals."

MR. ROBERT L. WARNER, in a paper read before the New England Railroad Club, entitled "Electrically-Driven Shops," gave an excellent discussion of direct-connected shop tools, illustrated by references to specific tools for various uses.

MR. ASA M. MATTICE has been appointed chief engineer of the Westinghouse Machine Company, but will retain a connection in a consulting capacity with the Westinghouse Electric & Mfg. Co., of which company he has for several years been chief engineer. Mr. B. G. Lamme will take up the former duties of Mr. Mattice with the title of Acting Chief Engineer.

MR. GEO. H. GIBSON has resigned as manager of the advertising and publication department of the B. F. Sturtevant Company, of Boston, Mass., to accept an appointment with the International Steam Pump Co., having offices at 114-118 Liberty St., New York City. Mr. Gibson was formerly connected with the Westinghouse Companies' publishing department, of Pittsburg, Pa., and was for two years a member of the editorial staff of *Engineering News*.

PROF. R. B. OWEN, of McGill University, Montreal, in view of the proposed operation of the horse, steam and cable tramways in Melbourne and vicinity and the conversion of surburban lines of the steam railroads in that part of the world, has been invited by the Victorian Government to prepare a report on the subject. He will visit the General Electric works, and will also gather data regarding suburban railway and tramway services in New York and Boston.

MR. EDWARD GUINLE, together with Mr. A. Aschoff, have purchased the business and assets of the electrical engineering firm of James Mitchell & Co., of Rio Janeiro and San Paulo, and will conduct the same with offices at both of the above-mentioned places under the firm name of Aschoff & Guinle. Both Mr. Aschoff and Mr. Guinle have many acquaintances in American electrical circles, the latter having taken a course of instruction in the Schenectady works of the General Electric Company.

MR. RALPH H. BEACH, head of the railroad department of the General Electric Company, left New York July 11 for Mexico. His visit to the Southern Republic is made for the purpose of determining what equipment is required for doubling the capacity of the Tula Iron Works, which are located in the Sierra Madre range of mountains in the State of Jalisco, district of Sayula, about 60 miles south of the City of Guadalajara. Mr. Beach expects to be back in New York about the first week in August.

Trade Notes.

THE SILLS-EDDY MICA COMPANY has established its main office at its Newark factory, the mailing address being box 135, Newark, N. J.

REMOVAL.—Richard Lamb, C. E., has removed his office to the Electrical Exchange Building, 136 Liberty Street, New York City, where he will continue a general engineering practice.

LAVITE.—The D. M. Stewart Mfg. Company, Chattanooga, Tenn., has issued a booklet under the title, "Mechanical and Electrical Properties of Lavite." This publication will be found of value and interest.

EUREKA FLEXIBLE CONDUIT.—The Rittenhouse Miller Company, Witherspoon Building, Philadelphia, has issued a circular pointing out the advantages of "Eureka" flexible conduit, and including a price list.

PASS & SEYMOUR, INC., in a little pamphlet entitled "Little Gem Rosettes," show in excellent half tone illustrations, printed on a good quality of paper, a line of rosettes for cleats, mouldings and concealed work.

NERNST LAMPS.—The Chicago office of the Nernst Lamp Company reports that Nelson, Morris & Co., of Chicago, are making tests of the Nernst lamps for office use, with a view to replacing their desk lights with these lights.

THE STROMBERG-CARLSON TELEPHONE MANUFACTURING COMPANY, of Rochester, N. Y., and Chicago, Ill., has recently sold a special type dispatcher's desk with telephones to the Interurban Railway & Terminal Company, of Cincinnati, Ohio.

STORAGE BATTERIES.—The Gould Storage Battery Company, New York City, has issued a bulletin on the subject of "Line Batteries." It describes the uses and advantages of line or "floating" batteries on feeder lines, and contains illustrations of installations, curves, etc.

GAS BLOWERS AND EXHAUSTERS.—The Buffalo Forge Company, Buffalo, N. Y., has issued a 24-page pamphlet describing and illustrating in detail its line of gas blowers and exhausters. The final pages contain illustrations of the Buffalo high-speed automatic engine.

THE NATIONAL WIRE CORPORATION, New Haven, Conn., has just issued to the trade a special price list of galvanized telegraph and telephone wire and wire strands. The price list contains valuable information, and any one interested can obtain a copy by addressing the company.

METERS AND TRANSFORMERS.—In a pamphlet issued by the Westinghouse Electric & Manufacturing Company, entitled "Some Facts about Meters and Transformers," an interesting account is given of the experience of a central station in reducing its meter and transformer losses.

MR. C. HUDSON MACHEN, sales engineer representing the Cutter Company, of Philadelphia, is prepared to submit blue prints and give any information required relative to I-T-E circuit-breakers and Keystone measuring instruments. Mr. Machen's office is at 120 Liberty Street, New York City.

THE ELECTRIC STORAGE BATTERY COMPANY, of Philadelphia, announces the change in address of its New York Exide Battery Depot, which was formerly located at No. 148 West Eighteenth Street. It will hereafter be operated by the New York Transportation Company, at Forty-ninth Street and Eighth Avenue.

THE CINCINNATI CONSTRUCTION COMPANY, which has done much work in consulting engineering on steam and electrical traction enterprises, will take up as a specialty the reconstruction of traction properties, which are run down through bad construction originally, or incompetent management. The officers of the company are W. P. Deppe, president and treasurer and E. Jarrow, secretary and chief engineer.

MOBILENE.—The H. W. Johns-Manville Company, 100 William Street, New York, in a postal card folder, points out that "mobilene" was a factor in the recent automobile record-breaking feat of B. E. Oldfield, at Indianapolis. The folder reproduces from the New York *Herald* an account in fac-simile of the record-making run, and also a letter in fac-simile from Mr. Oldfield, saying that the machine was packed with "mobilene."

MR. F. C. MOTT, recently associated with Mr. G. M. Gest, the conduit contractor, has been placed in charge of the New York office lately opened by the American Conduit Company, manufacturer of the electrolysis proof bituminized fiber conduit. This is in addition to its offices at Philadelphia, Chicago, and Los Angeles. The demand for this material during the past season has been very great, running into many millions of feet.

THE ELECTRIC APPLIANCE COMPANY, Chicago, is sending out illustrated and descriptive circulars of the new cartridge fuse ("The McBride Arkless" fuse), for which it is selling agents. This fuse is adapted for every fuse connection, and is made in 125 and 250 volts in any capacity from 3 to 30 amperes. It takes the place of link fuses, or fuse wire, and no change is necessary to adapt it for cutouts, switches, panel boards, switchboards, etc.

ENCLOSED FUSES.—The Chicago Fuse Wire & Manufacturing Company, of Chicago, New York and Buffalo, is putting on the market the "Union" line of enclosed fuses. These fuses are designed to fit all styles and sizes of bases in common use. The "Union" enclosed fuse embodies a number of orginal features, among them being an independent cartridge filling secured within the case. Inquiries may be addressed to any of the company's offices above named.

THE EUREKA ELECTRIC COMPANY dedicated its new factory at Genoa, Ill., on July 4, the ceremony being part of the town's official Fourth of July programme. Responses to toasts were made by President I. J. Kusel, Hon. Charles E. Fuller and others. The factory was christened by Mrs. Kusel and six young ladies, a bottle of Genoa artesian water figuring in the ceremony. In the evening a dedicatory ball was held in the building. Mr. A. L. Funk was chairman of arrangements.

THE ELECTRIC APPLIANCE COMPANY, Chicago, states it is meeting with great success in introducing the new "Zenith" Packard lamp. This lamp is made in two sizes, 25 to 55 cp, the latter in two efficiencies, 1.9 and 2.18. The lamp is ornamental, and while it consumes less current than a 32-cp lamp, it produces a much greater light. Its success is due, according to the claims of the selling agents, to the fact that it has the Packard label, and it is therefore a "dependable" intermediate between an arc and incandescent lamp.

L. B. ALLEN COMPANY, INCORPORATED, Chicago, has just issued for distribution to its patrons a set of four handsome three-color display boards. These hangers show the Allen soldering stick, paste, salts and the large and small size sticks of Allen commutator lubricant—in actual size and colors—cleverly grouped about an illuminated centerpiece, which is a true copy in colors of a masterpiece of modern art. These sample boards are 18 by 14 inches, and are all ready for hanging, and are at the service of dealers in Allen products.

ELECTRICITY IN A SUGAR REFINERY.—In its latest bulletin the D'Olier Engineering Company, Philadelphia, Pa., gives a well written and well illustrated description of a very complete electrical installation which that company has installed in the works of the Pennsylvania Sugar Refinery at Philadelphia. This is the first large manufacturing plant in America completely equipped with steam turbine apparatus, the De Laval steam turbine being employed where electric motors are not used. One illustration shows steam turbines driving pumps for boiler feed. The pumps for raw sugar, sugar liquids and syrups are all electrically driven, as are also the numerous centrifugal machines.

MAGNETO MULTIPLE TELEPHONE SWITCHBOARD.—The Ericsson Telephone Company, 296 Broadway, New York, has recently installed one of the handsomest and most efficient multiple switchboards in the South. It is built for the magneto system, and fitted with new combination indicator jacks that have been recently patented. The board is installed for 1,200 numbers, and has a capacity for 3,000. The main distributing rack for 1,200 numbers is fitted with carbon lightning arresters and heat coils; also a monitor desk with visuals for calling and clearing, and jacks for listening were installed. The woodwork on this board is made of mahogany with heavy piano finish, giving it a very fine appearance.

THE INTERNATIONAL CORRESPONDENCE SCHOOLS, Scranton, Pa., have recently added their extensive curriculum, a course in advertising. The "know-how" necessary for preparing a course in advertising comes from the best possible source, viz., successful practical experience, for it is a well-known fact that the International Schools are among the best advertisers in the country. The new course is written and conducted by Mr. George Frank Lord, the manager of the advertising department. Mr. Lord has prepared an attractive prospectus, giving full particulars about the course, and illustrating it of a number of the School's own advertisements, in reduced size, as well as advertisements on other subjects. The prospectus can be obtained by any one interested in this modern art.

JEFFREY OUTING.—The eighteenth annual outing of the employees of the Jeffrey Manufacturing Company, Columbus, Ohio, was held at Olentangy Park on June 27, and was a very elaborate and entertaining affair. The programme of amusements included races of all sorts, ladies' thread and needle race, swimming contests, prize waltzes, etc., and there was dancing afternoon and evening and a baseball game in the afternoon. There was also a play in the theatre both afternoon and evening, the piece presented being "The Senator." A rather interesting note is made in the programme to the effect that the company employs so many persons that none of the railroads out of Columbus would undertake to carry them all to a more distant point. Mr. J. A. Jeffrey, president of the company, states that the number of employees would require 65 to 75 coaches to transport them. For the various games first and second prizes were given, and judging from the excellent programme no doubt everybody present had a very enjoyable time.

Record of Electrical Patents.

UNITED STATES PATENTS ISSUED JULY 7, 1903.

[Conducted by Wm. A. Rosenbaum, Patent Attorney, 140 Nassau St., N. Y.]

732,695. ELECTRIC SWITCH; Charles F. Autenrieth, Brooklyn, N. Y. App. filed Aug. 2, 1902. A cord connects with a ratchet on a ceiling switch so that successive pulls on the former will alternately open and close the circuit.

732,701. ELECTRIC ARC LAMP; Robert Broderick and Frank W. Gordon, Cleveland, Ohio. App. filed Jan. 6, 1903. Details.

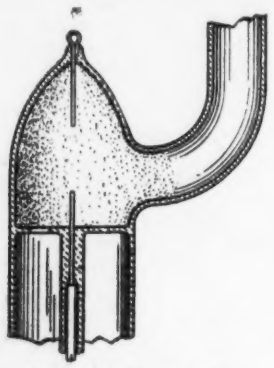
732,737. ALARM SIGNAL FOR ELEVATORS; Edward L. Hail and George Hail, Providence, R. I. App. filed July 30, 1902. Signals and circuit controllers are arranged at the various floors in such a manner that while the car is moving, one signal is always in operation, but while the car is standing at a landing, the signal is quiet.

732,745. ELECTRIC SWITCH; John D. Ihlder, Yonkers, N. Y. App. filed May 5, 1902. A reversing switch particularly applicable to polyphase alternating current circuits.

732,753. ELECTROLYTIC MANUFACTURE OF CHLORATES AND PERCHLORATES; Pierre Lederlin, Chedde, France. App. filed July 11, 1902. (See page 101.)

732,768. LOCOMOTIVE; Seward N. Mighell, Chicago, Ill. App. filed Dec. 15, 1902. A mining locomotive provided with a take-up device for the flexible trolley conductor.

732,811. GALVANIC BATTERY; Edward L. Anderson, St. Louis, Mo. App. filed July 9, 1902. A carbon vessel having a cover at the bottom held in place by a flange on the surrounding zinc element.



732,823.—Adjustable Vacuum Tube.

732,813. ELECTRICAL SIGNAL FOR ADDING SECURITY TO SAFES; Wilber E. Arnold, Madisonville, O. App. filed May 1, 1902. Alarm circuit closers are arranged at various places in the neighborhood of a safe to indicate when the latter is approached.

732,822. ALTERNATING-CURRENT INDUCTION MOTOR; Charles S. Bradley, Avon, N. Y. App. filed Oct. 7 1895. (See Current News and Notes.)

732,823. ADJUSTABLE VACUUM TUBE; Mark H. Branin, Newark, N. J. App. filed Mar. 8, 1898. The tube contains a chemical capable of giving off a gas by the action of current flowing in the tube, to lower the vacuum.

732,842. SECONDARY BATTERY; William Gardiner, Chicago, Ill. App. filed Jan. 23, 1902. (See page 101.)

732,843. METHOD OF PREPARING ELECTROLYTES; William Gardiner, Chicago, Ill. App. filed Jan. 23, 1902. (See page 101.)

732,851. SOLENOID MAGNET; George T. Hanchett, Hackensack, N. J. App. filed March 19, 1901. Details of construction whereby the pulling power of the magnet can be adjusted and balanced against springs or weights attached to the armature.

732,875. CONTROLLER FOR ELECTRIC MOTORS; Frank A. Merrick and Emmett W. Stull, Johnstown, Pa. App. filed May 7, 1901. A switch controlling two motors adapted to throw them into series or parallel and for cutting one out of circuit and establishing a working circuit through the other in both the series and parallel positions.

732,888. ALTERNATOR; Charles A. Persons, Newcastle-Upon-Tyne, England. App. filed Oct. 6, 1902. Consists in employing two or more rotating elements and one or more fixed elements combined differentially in such a way that their relative speeds of rotation give a low frequency.

732,890. PUSH BUTTON ELECTRIC SWITCH; Charles G. Perkins, Hartford, Conn. App. filed Jan. 19, 1903. Details.

732,943. CLUTCH MECHANISM; Camille Jenatzy, Fils, Brussels, Belgium. App. filed Dec. 16, 1902. A magnetic clutch in combination with a rheostat for controlling the clutching power.

732,944. TRANSMISSION DEVICE FOR MOTOR VEHICLES; Camille Jenatzy, Fils, Brussels, Belgium. App. filed March 17, 1903. The engine drives a small dynamo which supplies the power to operate an electromagnetic clutch between the engine and traction wheels, a rheostat being introduced in the dynamo circuit for controlling purposes.

732,967. TROLLEY POLE; Ernest Schlicker, Pittsburg, Pa. App. filed Feb. 21, 1903. Details.

733,015. TROLLEY; Arthur S. Deem, Reading, Pa. App. filed July 9, 1901. Two trolley wheels mounted in a frame pivoted upon the arm, with which are used a pair of fingers capable of being thrown over the wire to retain the trolley in place.

733,028. ELECTROLYTICALLY COATING IRON WITH ZINC; Emanuel Goldberg, Moscow, Russia. App. filed April 17, 1902. (See page 101.)

733,035. MEANS FOR VARYING THE SPEED OF OVERHEAD ELECTRIC CARRIERS; Henry M. Harding, New York, N. Y. App. filed Aug. 22, 1902. A rheostat automatically operated by the carrier at grades to vary the power.

733,040. ELECTRIC FURNACE; Paul Louis Toussaint, Héroult, La Praz, France. App. filed March 27, 1902. (See page 101.)

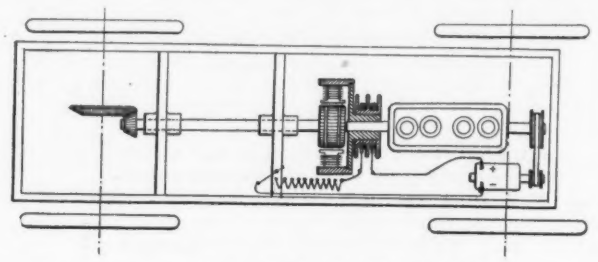
733,064. CABLE HANGER; Eugene S. Marsh, Bridgeport, Conn. App. filed Oct. 20, 1902. Details.

733,097. ELECTROMAGNET; Isaac G. Waterman, Santa Barbara, Cal. App. filed Aug. 4, 1902. An iron clad magnet in which the heads of the magnetic circuit have sleeve projecting inward and outward.

733,135. ELECTRIC ARC LIGHT; Frank Buchanan, Dayton, O. App. filed Jan. 2, 1903. Details.

733,146. SWITCH FOR ELECTRICAL APPARATUS; Eugene R. Carichoff, East Orange, N. J. App. filed Aug. 1, 1901. Details.

733,149. METHOD OF CHANGING THE FREQUENCY OF SINGLE PHASE INDUCTION MOTORS; Penrose E. Chapman, St. Louis, Mo.



732,944.—Transmission Device for Motor Vehicles.

App. filed April 15, 1902. The invention consists of two or more "phase" or "teaser" coils, one placed within the other and main coils wound around one or several polar projections and connected in series with each other, such phase coils being of higher resistance than the main coils and leading the latter in phase.

733,159. ELECTRIC CLOCK; Ulysses L. Collins, St. Louis, Mo. App. filed May 12, 1902. Details.

733,169. TROUGH OR CONDUIT FOR UNDERGROUND ELECTRIC CABLES; Thomas E. Devonshire, Chislehurst, England. App. filed Nov. 8, 1902. The trough or conduit is built up of cement in which wire net work is embedded.

733,178. DRY BATTERY; Eugene M. Fishell and Marcus H. Moffett, Cleveland, O. App. filed April 14, 1902. Relates to the construction of a box for a number of cells of dry battery.

733,184. THERMOSTAT; John D. Gould, New York, N. Y. App. filed Feb. 7, 1902. A cable having a fusible and a non-fusible wire normally insulated, is provided with a terminal which insures the electrical connection of the two wires when the fusible conductor is melted.

733,188. ELECTRIC LIGHTING DEVICE; Henry C. Graybill, Altoona, Pa. App. filed Oct. 22, 1902. Details of a switching apparatus.

733,225. ELECTRIC BELL RINGER; Tiodolf Lidberg, Chicago, Ill. App. filed Nov. 20, 1901. Details.

733,232. WINDING FORM; Julius W. Lundskog, Lynn, Mass. App. filed June 21, 1901. A winding form for armature coils.

733,233. METHOD OF WINDING COILS; Julius W. Lundskog, Lynn, Mass. App. filed June 21, 1901. A method of winding coils composed of a number of separate wires whereby the conducting leads may be brought out at the outside of the coil without objectionable crossing.

733,234. METHOD OF FORMING COILS; Julius W. Lundskog, Lynn, Mass. App. filed June 21, 1901. Pieces of insulation which soften under high temperature are inserted between the layers of winding, which are then subjected to heat and pressure.

733,252. MOTOR CONTROL SYSTEM; William O. Mundy, Schenectady, N. Y. App. filed Jan. 2, 1902. In a multiple unit system, the arrangements are such that the operation of the circuit controlling switches in all operations of the master controller will be dependent upon the proper operation of the reversing switch.